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Excavation for the Arrowrock Dam, Idaho

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SYNOPSIS—The Arrowrock Dam will be the highest dam in the world and its construction will take five or six years. The heavy flood flows to which the river is liable led to the decision to build diversion works sufficiently large to carry heavy, but not the heaviest, floods, and then to excavate a foundation pit clear across the cañon bed, but wide enough for only the upstream portion of the foundation, and then to build that portion of the foundation up to a level slightly above the natural bed of the stream. This was successfully done between the summer floods of 1912 and 1913, so that if there should be a very heavy flood in 1913, it could flow over the work without damage. Subsequently, the remainder of the foundation pit will be excavated and the foundation continued. The 170,000 cu.yd. of excavation in this first work was completed during the fall of 1912. Two cableways were employed; also a steam shovel, dinkey locomotives and dump cars. A drag-line excavator, and orange-peel buckets handled by two stiff-legged derricks were used in loading the skips. On a part of the work the skips were moved from and to the cableways by the derricks. Hydraulic jets and blasting were used in loosening and breaking some of the material. A pumping plant was provided, but was used less than was expected. The

FIG. 1. EXCAVATION AT ARROWROCK DAM, LOOKING DOWNSTREAM

(Diversion tunnel and uncompleted coffer-dam in foreground. Both main cableways are shown, one just starting up with loaded skip, the other with loaded skip hoisted ready to start traveling. At extreme left is shown part of hopper into which skips are dumped, and screened material stored on bench, to be used later in concrete. Drag-line excavator loading skips in middle distance. Steam-shovel outfit in background.)

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excavation work and apparatus are described in this article, and details of cost are given at its close. Particular attention is called to the cableway records shown by Table I, and to the small differences between the average time for moving skips and the average of the best day's record.

The Arrowrock Dam is being built by the U. S. Reclamation Service for irrigation storage purposes in connection with the Boise Project. It is located in the Canyon of the Boise River about 20 miles above the city of

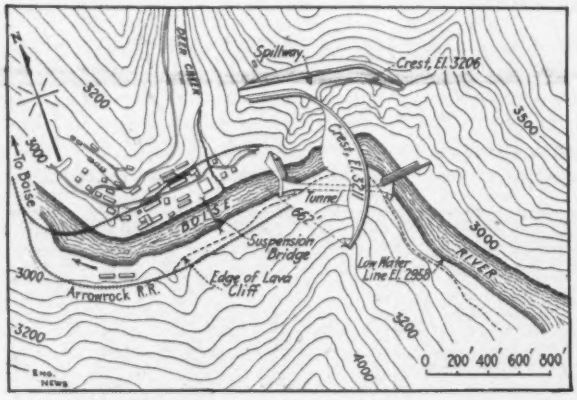


FIG. 2. GENERAL PLAN OF ARROWROCK DAM-SITE AND CONSTRUCTION CAMP
(Reproduced from "Engineering News," June 6, 1913.)

Boise, Idaho. It will have a total height of about 350 ft. and will be the highest dam in the world.†

The depth to bedrock for the foundation is from 60 to 80 ft. below the river bed. The width of the cañon at the river bed is about 200 ft., and the thickness of the dam at the bottom will be about 240 ft. The estimated amount of excavation in the river bed is some over 230,000 cu.yd., not including the stripping of the abutments.

A general plan of the dam is shown by Fig. 2, while Fig. 3 shows more clearly the diversion works and the general scheme of excavation preparatory to beginning the construction of the dam proper. Figs. 1, 4, 5 and 6, with the explanatory notes beneath their titles, give a good general idea of the excavation work, which work is described in detail in this article.

The flow of the Boise River at Arrowrock varies from a minimum of 400 or 500 sec.-ft. (cu.ft. per sec.) to a maximum of about 16,000 sec.-ft., with an occasional flood of about 20,000 sec.-ft., and with a possibility of a flood flow reaching about 30,000 sec.-ft. once in twenty or thirty years. The low-water period extends from about August to February or March, although floods of considerable magnitude have been recorded in November. There is usually a flood amounting to from 5000 to 10,000 sec.-ft. either in February or March, and what is known as the June flood starts in any time between the middle of April and the middle of May and continues to about the first or middle of July.

The excavation problem was one that early demanded the attention of the engineers and the general plan was worked out only after careful study and considerable discussion. On account of the uncertainty as to the amount of pumping that would be required, it was considered undesirable to open up the whole of the excavation at one time unless this proved to be absolutely necessary. It was out of the question to consider handling the whole excavation between flood periods, for even though it might have been possible to accomplish the work of excavating alone, it would be necessary in order to be out of danger from floods to place enough concrete in the dam to bring the elevation of the concrete up to the river level, which would involve the placing of from 100,000 to 150,000 cu.yd. Excavating and concreting small sections of the dam by the use of caissons was considered, but was objectionable for several reasons. It was finally decided to build diversion works (Figs. 1 to 4) to take care of about 20,000 sec.-ft. and to excavate for, and built first, a section of the dam (Fig. 3). along the upstream face extending entirely across the cañon, with a height of about 100 ft., which would bring its top about 10 ft. above the top of the upper cofferdam, and with a cross-section heavy enough to stand by gravity for that height. Under this plan, it was not

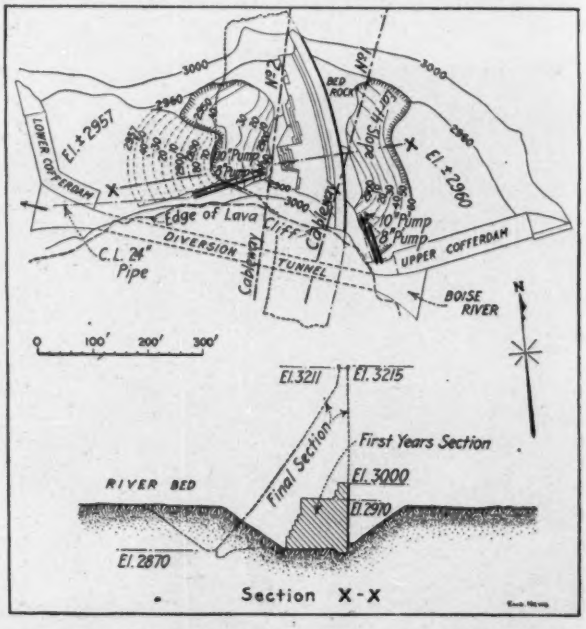


FIG. 3. GENERAL PLAN OF DIVERSION WORKS AND EXCAVATION FOR ARROWROCK DAM, WITH CROSS-SECTION OF DAM

necessary to open up all of the excavation at once, and it was quite possible, if no particularly bad luck was encountered, that this excavation might be accomplished and the first section of the dam brought up to its full height between flood periods, so that overflow of the coffer-dams or any trouble with them during the flood period would not be serious. After this first section of the dam was built it was considered a comparatively simple matter to complete the remainder of the excavation having the completed work to serve as a protection against seepage from the upstream side and as an effective barrier against any flood that might occur.

The excavation for this first section of the dam, amounting to a total of 170,000 cu.yd. (including strip-

†See "Engineering News," June 6, 1912, for description of the general plan of the work and the preliminary and incidental operations, and Jan. 16, 1913, for general design and specifications for the dam proper. A description of the construction of the Diversion Works appeared in the "Engineering Record" for Apr. 6, 1912.

ging from abutments) has been completed, and the concrete work has been brought up to practically its full height (Apr. 15, 1913), well in advance of this year's flood.

General Description of Work

The character of the material in the river bed was largely gravel and sand with perhaps 5 to 10% of boulders exceeding two-man size, all of which was good material for concrete, but along the north side of the river the material was principally large granite boulders which had sloughed off the cliffs from time to time, embedded in disintegrated rock and dirty material unsuitable for use in concrete. Fortunately, this material had remained close along the north side of the river and was not mixed to any great extent with the river gravel just mentioned. Practically all of this material along the north side, as well as a considerable quantity of loose and seamy granite that was cleaned off the cliff as the work progressed, was moved by a steam shovel, loaded into dump cars and wasted along the river bank both upstream and downstream from the damsite. The remainder of the excavation in the river bed, consisting of about 110,000 cu.yd., was excellent concrete material, and as suitable material for concrete was not plentiful in the vicinity of the damsite, and because in any case a considerable quantity of it would have to be either manufactured from the natural rock or hauled in from borrow pits along the line of the Arrowrock Railroad, it was decided to take steps to save for concrete material all the excavated material from the river bed that was suitable for this purpose.

Two cableways were erected in such a way as to cover this work to good advantage. A drag-line excavator working in the pit between the lines of these two cableways loaded the material into skips and these skips were lifted and conveyed by the cableways to a large hopper on the south side of the river under which was located the screening and crushing plant. Two stiff-leg derricks located at the south side of the river on the edge of a steep cliff commanded a portion of the excavation that could not be reached conveniently by the drag line, and these derricks were used to move loaded skips to a position where they could be reached by the cableways. From these derricks also were operated orange-peel buckets which were used in excavating for the pump sumps located at the southeast and southwest corners of the excavation. Some of the excavated material that could not be reached by the drag line was loaded into skips by hand. This work was handled in three 8-hr. shifts. Most of the work, however, was performed by two shifts, and the third or graveyard shift, spent most of the time in cleaning up and straightening around for the next day's work, attending to what drilling and blasting was

Fig. 4. Looking Upstream, Excavation for Arrowrock Dam

(Upper coffer-dam uncompleted in distance. Drag-line excavator in foreground. Cableway just starting up with loaded skip at left. Loading skips by hand in further corner and moving them over to line of cableway by means of stiff-leg derrick on cliff.)

necessary and doing other work that could not well be done during the other shifts without interfering with the progress of the excavation.

Equipment

Steam Shovel—The steam shovel is a 70-ton Atlantic of the latest model, with a 140-hp. boiler, and is equipped with a 2-yd. and a 2½-yd. dipper. In connection with the steam-shovel outfit, three 16-ton dinkey locomotives were used, two of which were Vulcan and one American, and about twenty-five 4-yd. dump cars, some of which were Kilbourne & Jacobs and some Western.

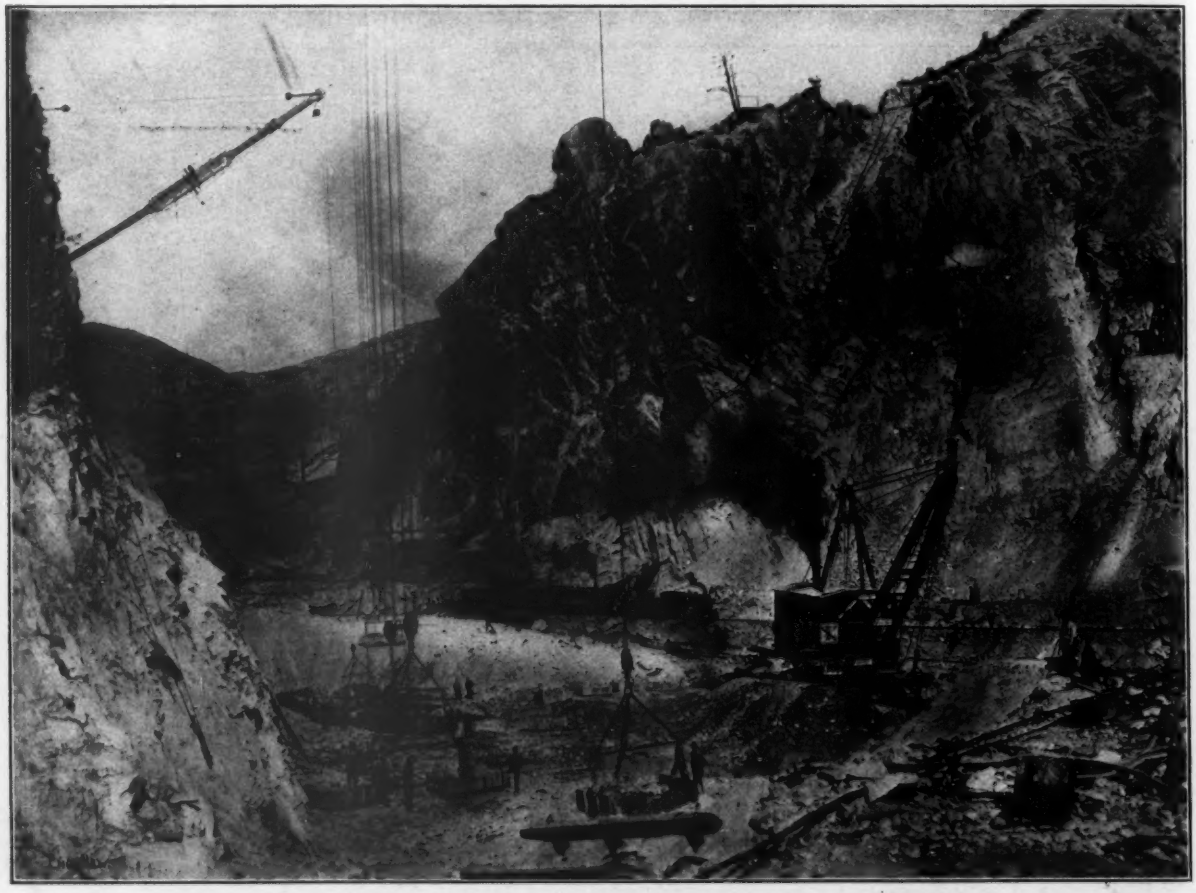


Fig. 5. Excavating for the Arrowrock Dam, Looking Downstream

(Steam shovel in distance. Drag-line excavator in foreground. The two pairs of blocks are suspended from the main cableways, 300 ft. above. The further cableway is just taking up a loaded skip. The stiff-leg derrick from top of cliff at left—boom only shows—is swinging a loaded skip over within reach of cableway. The cableway in the foreground has just dropped an empty and is swinging over to pick up a loaded skip from in front of the drag line.)

Drag-Line Excavator—The drag-line excavator was designed and built by Chas. Stone, of the Hoy & Elzy Construction Co., and was used by that company on some construction work in the vicinity of Boise before being purchased for the Arrowrock work. It is equipped with a 70-hp. vertical boiler and a 2-yd. bucket, carries a 70-ft. boom and is similar to the ordinary type of drag lines now on the market. The body and boom construction are of timber and the whole machine is mounted on skids and rollers.

Cableways—The cableways were furnished by the Lidgerwood Manufacturing Co. Both are stationary, with a span of about 1300 ft., capable of hoisting an average load of 8 tons on a 4-part line at a load speed of 300 ft. per min., and of conveying the same at a speed of 1200 ft. per min. These cableways will also handle an occasional maximum load of 12 tons. The main cable has a diameter of 2¼ in. and is of the patent locked type. The hoisting, conveying, dumping and button ropes are of ¾-in. diameter, 19-wire, hemp center. The carriage is of the 3-main cable wheel type, arranged for four-part hoisting purchase in combination with fall blocks and dump block, and equipped with an oscillating horn for operating the fall-rope carrier system. The fall-rope carriers are of the Panama type. The cableways are equipped for aërial dumping and are suitable for handling skips or clam-shell buckets. The hoists are special, triple-friction drum, gear connected to a 300-hp., 2200-volt motor, 575 r.p.m., adapted to alternating, 3-phase, 60-cycle current. All levers for operating frictions and brakes are assembled in a quadrant stand at the rear of the hoist. The conveying drum is 53 in. in diameter, of the removable-rim type, with inset steel-plate wearing surface. The two hoisting drums are arranged tandem, each approximately 50 in. in diameter with 42-in. face. The upper or rear hoisting drum, on the same shaft with the conveying drum, is used for the main hoisting rope and is provided with a Raybestos brake. The front or

Lower hoisting drum is mounted upon a separate shaft with its own friction and gear, of the same diameter as the other hoisting drum, so as to run in unison with it, and is used for operating the dumping rope.

Skips—The skips were built of ⅜-in. steel, 8 ft. square and 2 ft. deep, with an open end. These skips were handled by means of spreader bars consisting of a piece of 3½-in. extra heavy wrought-iron pipe 8 ft. long solidly filled with a hickory filler, with heavy chains hooked into links on each side of the skip just ahead of the center of gravity, and a third chain to which the dump line was attached engaging a hook on the skip at the center of its rear end.

located at the side of the hoist. In front of the main drums a reversible two-drum swinging gear is mounted on a bedplate securely attached to and made a part of the main frame of the hoist. These hoists are gear connected to a 75-hp., 440-volt motor adapted to 3-phase, 60-cycle, alternating current.

Pumping—The amount of water that it would be necessary to handle in taking out this excavation was always problematical until bedrock was finally encountered. It was estimated that there might possibly be as much as 50 sec.-ft. and since any delay after the excavation was once started would be serious, it was decided to provide enough pumping equipment to handle nearly this max-

Fig. 6. Looking Upstream in Excavation for Arrowrock Dam

(Orange-peel bucket in foreground, digging sump, operated from stiff-leg derrick on edge of cliff. Drag-line excavator loading skips. Loaded skip hanging in front of drag line, to left of boom, just being lifted by cableway.)

Derricks—The two stiff-leg derricks are of timber construction, equipped with 10-ton derrick irons furnished by the American Hoist & Derrick Co., and adapted to handle either excavating buckets or dumping skips. The booms are 80 ft. long, heavily trussed, and all fittings as well as the hoists are guaranteed for a maximum load of 10 tons with the boom in any position. The derricks are rigged to handle the load on a two-part hoisting purchase at a speed of load in hoisting of 100 ft. per min. The hoists, which were also furnished by the American Hoist & Derrick Co., are equipped with three tandem friction drums, each of 16-in. diameter and 30-in. face and each drum is provided with friction foot brakes and ratchet and pawl. The operating levers are

imum estimated quantity at the time the work was started. It was also considered possible that the cofferdams might be overtopped by an extreme flood during the progress of the excavation, for although the behavior of the Boise River may be fairly well predicted for most years, there have been records of floods at most unexpected seasons and the topography of the watershed and other conditions are such that a large flood is entirely possible at any season of the year excepting during midsummer. For this reason it was considered wise to provide a pumping outfit that could be quickly removed from the hole in case the work should be flooded, so that valuable pumps and motors would not be lost or put out of business if such a contingency occurred.

Two parallel inclined tracks were built on the slope of the excavation (about 1½ to 1 slope) and close to the cliff at the southeast and southwest corners, and on each of these tracks was placed a truck carrying an 8- or a 10-in. Byron-Jackson, closed-runner centrifugal pump, belt connected to a motor suitable for lifting the amount of water determined by the full capacity of the pump to a height of 90 ft. At each of the two points, a pair of pumps, one an 8-in. and one a 10-in., was installed. In each case the 8-in. pump was controlled by a 75-hp. variable-speed motor and 125-hp. constant-speed motors were connected up to the 10-in. pumps. All these motors were 2200-volt adapted to 3-phase, 60-cycle alternating current.

Each of the pumps had separate discharge pipes up to the elevation of the old river bed, where the two pipes discharged into one larger pipe which was carried along at the elevation of the river bed and through the upper or lower coffer-dam, as the case might be. These discharge pipes passed through the coffer-dams at an elevation just above the low-water surface in the river and low enough so that when the river rose the ends would be submerged. By this arrangement it was necessary to pump only against a head due to the actual height of the water in the river and not to the additional height necessary to carry the water over the tops of the coffer-dams.

A hand crab installed on the pump trucks, with a cable anchored to the cliff at the upper end of the track, controlled the position of the pumps, and proper arrangements were made in the design of the discharge pipe so that it could be quickly disconnected and left to one side of the track and the truck carrying the pump and motor could be raised by means of the hand crab to a height sufficient to be out of danger from flooding. Arrangements were made also to install a third unit if needed, consisting of another pair of pumps like those just described, and it was also planned to excavate, if necessary, shallow sumps just back of the upper and lower coffer-dams and install at each point several low-lift open-runner pumps to catch and handle any seepage that could be advantageously caught near the surface before it found its way into the deep cut.

Much to the surprise of all concerned, there was no time during the progress of the excavation when one 8-in. pump did not easily handle all the seepage, although as soon as concreting was started it was necessary for convenience to use two pumps, one above and one below the work.

Description of Detailed Operations

The steam-shovel work along the north side of the river was started on Feb. 27, 1912. At this time the river had not been turned through the diversion tunnel, but there was a considerable quantity of material above the water level and some that had been thrown down from the spillway excavation that the steam shovel could handle to advantage before the diversion of the river. There was nothing especially noteworthy about the performance of this steam-shovel work excepting that the material was about as hard to handle as could well be imagined. The boulders encountered were of all sizes up to a maximum of perhaps 150 cu.yd. In places they were closely nested together and the spaces between them solidly packed with finer material. In fact, a great deal of the material as it stood was so solidly packed that it could be, and was, drilled to advantage with Burley drills.

Of course, the shooting could not be handled nearly as efficiently as if the material had been solid rock, and in order to make any reasonable progress, the shovel was necessarily subjected to very hard usage. Generally speaking, however, this part of the work was handled like most steam-shovel cuts of a similar nature. This work progressed without interruption until about Oct. 10, 1912, when practically all of the material not suitable for use in concrete had been removed and the steam shovel was dismantled and moved to another part of the work. In the meantime the river had been diverted through the tunnel and steam-shovel excavation had been carried down to a depth of about 30 ft. below the river bed.

The entire flow of the river was diverted through the diversion tunnel on July 5, 1912, and the operations of the drag-line excavator, cableways and derricks were started at that time. On account of the fact that the dam was curved in plan, and because of the topography of the country, it was not possible to place the cableways parallel to each other and thus command the work to advantage, and the final location for these cableways was with the head towers on the north side of the river about 275 ft. apart and with a common tail tower on the south side of the river, which was built also to take a third cableway if this was found necessary at a later stage of the work. Just in front of this tail tower was located the hopper over the screening plant, into which the material from the excavation was dumped. By this arrangement both cableways could dump into the same hopper at points about 40 ft. apart.

A row of skips numbering about 6 or 8 in a row was placed under each of the cableways, the drag-line excavator was moved to a point between the two cableways where it was out of danger from rocks that might fall from the skips, and these skips were loaded first on one side and then on the other so that there was always a loaded skip ready to be picked up by the cableways as soon as it had returned with an empty. Six hookers looked after the hooking and unhooking of the skips, the turning of them into the proper position for loading with the drag line, and the steadying of them as they were started off the ground by the cableways.

On account of the unusual height (about 275 to 350 ft.) to which these skips had to be lifted, the lines were very liable to become twisted unless the skips were carefully steadied before the hoisting began, but the hookers soon became very expert in doing this work in the minimum amount of time.

The cableway operators could not see the operations in the pit, but handled the cableways entirely by signals received from signalmen stationed at convenient points commanding the scene of operations. Both the cableway operators and the signal men were provided with regular telephone-operator head sets, and a special telephone connected them so that they were in constant communication. An entirely independent bell system was also installed, so that in case anything went wrong with the telephone there would be no delay to the work. As a matter of fact, it was the usual practice to use both systems at the same time, using the bells for start, travel, and stop signals and the telephone for adjusting of the skip before lifting and just before landing.

Skips could easily be lifted from and landed at points

20 ft. or so on either side of the lines of the cableways, and with some little trouble and delay it was possible to handle them over much greater distance than this. Some of the excavation that could not be reached with the drag line was loaded into skips by hand and it was sometimes necessary to resort to hand mucking in order to keep the cableways busy up to their full capacity, for in some of the material encountered the drag line was not able to load the skips fast enough. A good part of this portion of the excavation was handled without any shooting, but it was found of advantage to loosen up some of it with powder, and this work was always performed on the graveyard shift when the active operations of excavating were not in progress.

The drag line was moved back and forth across the river (but always between the cableways) so that it commanded a large percentage of the excavation. In the two corners at the south side, however, on account of the convergence of the cableways, the drag-line excavator could not reach all of the material without getting under the cables, and a good part of this excavation was handled by the stiff-leg derricks. Orange-peel buckets operated from these derricks did good work in handling some of this material as well as in digging the pump sumps. Skips were loaded by this means and these skips were handled in the same way as has been described heretofore. A large part of the material in these corners was loaded into skips by hand, and in these cases the derricks were used to move these skips over within reach of the cableways.

Streams of water carried through 2½-in. hose and 1-in. nozzles, and working under 150 lb. pressure, which was obtained from a gravity supply, were used to work down the slopes at the upstream and downstream limits of the excavation and to wash the material over to a point where the drag-line excavator could reach it. All boulders that were too large to be taken by a No. 5 crusher were broken up in the pit before being loaded into the skips and sent up to the screening and crushing plant. Every effort was made during all of these operations to keep the cableways working up to their maximum possible speed, and every man from the hookers to the cableway operators, including the drag-line crew and the signal men, was trained to keep this idea constantly in mind, and always to give the cableways right of way over anything else.

The work had been in progress but a short time before all of these men became particularly expert in their work, and it was not long before the hookers were able to place an empty skip and start off a loaded one in less than half the time that it had taken them at the beginning of the work. On one of the cableways which landed the skips, without turning, in the proper position for loading, it was customary for the hookers to land an empty, unhook it, and pick up and steady a loaded skip ready for hoisting in 20 seconds or less. Intense rivalry soon sprang up between the two shifts and even between the two cableway outfits on the same shift, which did much to increase efficiency and output.

Bedrock was first reached on Oct. 18, 1912, and on Nov. 11 enough of it was cleaned off so that concreting could be started to advantage. The bedrock was a very excellent quality of granite, very hard, and most of it was water worn and full of large and small potholes and caverns. Over a considerable area of this bedrock, very little work was necessary before concrete was placed on it except, of course, a very scrupulous cleaning and scrubbing. Loose and seamy rock, wherever encountered, was removed and a keyway about 8 to 10 ft. deep was cut out of the bedrock across the whole channel of the river and up the abutments just at the upstream face of the dam. In excavating this keyway and in cleaning up the bedrock generally, hand hammer drills were used almost exclusively and very light shooting was done, although some Burley drilling was done in the keyway in roughing out the excavation for it.

This work was done under the immediate direction of James Munn, superintendent of construction. F. E. Weymouth is supervising engineer of the Idaho District of the U. S. Reclamation Service. The writer is construction engineer in charge of the construction of the Arrowrock Dam and related features.

Table I shows the performance of the cableways during

TABLE I. CABLEWAY OPERATIONS AT THE ARROWROCK DAM, IDAHO.

Date 1912	Graveyard Shift Loads moved	Graveyard Shift Cu.yd. moved	Graveyard Shift Av. load per trip, cu.yd.	Morning shift Loads moved	Morning shift Cu.yd. moved	Morning shift Av. load per trip, cu.yd.	Afternoon shift Loads moved	Afternoon shift Cu.yd. moved	Afternoon shift Av. load per trip, cu.yd.
July				3,267	8,260	2.53	2,894	7,320	2.53
August	211	470	2.26	6,200	13,996	2.26	5,890	13,296	2.26
September	90	240	2.55	5,318	13,578	2.55	5,641	14,403	2.55
October	129	350	2.67	5,604	14,974	2.67	5,380	14,376	2.67
Totals and averages	430	1060	2.47	20,389	50,808	2.49	19,805	49,395	2.49

Record of delays, etc.

Graveyard Shift	Hr.	%	Morning shift	Hr.	%	Afternoon shift	Hr.	%
Time spent moving material	32	5	Time spent moving material	1502	83	Time spent moving material	1346	83
Service work; no work and all other delays	584	95	Service work	71	4	Service work	47	3
Note: This shift was devoted principally to service work for the benefit of other shifts.			Delays:			Delays:		
			Electrical trouble	8		Electrical trouble	6	
			Engine trouble	37	2	Engine trouble	37	2
			Cable trouble	79	4	Cable	61	4
			Miscellaneous trouble	29	2	Miscellaneous trouble	28	2
			No work	94	5	No work	107	6
	616	100		1820	100		1632	100

Note: This shift operated the cableways six hours each shift.

Average time moving skips (delays deducted)

Graveyard Shift	Morning shift	Afternoon shift
All operations	All operations	All operations
Cableway No. 1.....4 min. 5 sec.	Cableway No. 1.....3 min. 59 sec.	Cableway No. 1.....3 min. 59 sec.
Cableway No. 2.....4 min. 38 sec.	Cableway No. 2.....4 min. 36 sec.	Cableway No. 2.....4 min. 36 sec.
Best month:	Best month:	Best month:
Cableway No. 1.....3 min. 53 sec.	Cableway No. 1.....3 min. 30 sec.	Cableway No. 1.....3 min. 30 sec.
Cableway No. 2.....4 min. 33 sec.	Cableway No. 2.....4 min. 26 sec.	Cableway No. 2.....4 min. 26 sec.
Best week:	Best week:	Best week:
Cableway No. 1.....3 min. 50 sec.	Cableway No. 1.....3 min. 29 sec.	Cableway No. 1.....3 min. 29 sec.
Cableway No. 2.....4 min. 28 sec.	Cableway No. 2.....4 min. 23 sec.	Cableway No. 2.....4 min. 23 sec.
Best day:	Best day:	Best day:
Cableway No. 1.....3 min. 24 sec.	Cableway No. 1.....3 min. 6 sec.	Cableway No. 1.....3 min. 6 sec.
Cableway No. 2.....3 min. 40 sec.	Cableway No. 2.....3 min. 34 sec.	Cableway No. 2.....3 min. 34 sec.
Record runs	Record runs	Record runs
1 cableway.....8 hr. 138 skips	1 cableway.....8 hr. 149 skips	1 cableway.....8 hr. 149 skips
2 cableways.....8 hr. 269 skips	2 cableways.....8 hr. 265 skips	2 cableways.....8 hr. 265 skips

REMARKS:—Distances: Average hoisting distance, 300 ft. Average traveling distance, 500 ft. Yardage shown in above table was measured as material in place. The operation of Cableway No. 2 is slower than No. 1 on account of extra time required in placing and handling skips in pit, and greater hoisting distance. The morning and afternoon shifts operated the cableways eight hours each shift. Character of material—Well packed river gravel and sand with about 5 to 10% of boulders exceeding 2-man size.

TABLE II. COST RECORDS FOR THE ARROWROCK DAM, IDAHO

Excavation for Dam Foundation, First Section 170,700 cu.yd.

Steam shovel operations—	Solid rock		27,300 cu.yd	
	Other material		30,400 cu.yd.	
			57,700 cu.yd.	
Shovel,				
Labor		$6,935.49		
Fuel		2,122.75		
Supplies		1,732.79		
Miscellaneous		5.65		Per cu.yd.
Repairs		2,496.99		
Depreciation		905.48	$14,199.15	24.6c.
Dinkey trains,				
Labor		5,498.11		
Fuel		1,710.99		
Supplies		606.22		
Track maintenance		2,852.63		
Repairs		1,773.98		
Depreciation		1,214.80	13,746.73	23.8c.
Preparatory expense			1,099.89	1.9c.
Total			20,045.77	50.3c.
Cableway operations, including drag line, derricks and hand labor	Solid rock		12,000 cu.yd.	
	Other material		101,000 cu.yd.	
			113,000 cu.yd.	
Drag line, loading skips,				
Labor		9,411.95		
Fuel		2,357.40		
Supplies		3,092.26		Per cu.yd.
Repairs		1,801.81		
Depreciation		2,025.26		
Preparatory expense		1,012.63	19,701.31	17.4c.
Derricks, loading and moving skips,				
Labor		5,203.01		
Power		1,049.60		
Supplies		267.25		
Repairs		402.49		
Depreciation		1,589.89		
Preparatory expense		2,119.66	10,631.90	9.4c.
Miscellaneous, hookers, and hand labor,				
Loading		38,683.61		
Cleaning foundation		1,537.25		
Miscellaneous minor operations		2,532.02	42,752.88	37.8c.
Operating cableways,				
Labor		12,526.43		
Power		4,472.69		
Supplies		1,717.15		
Repairs		5,314.11		
Depreciation		7,280.51		
Preparatory expense		10,429.30	41,740.19	37.0c.
General preparatory expense			10,158.62	9.0c.
			124,984.90	$1.10
Drilling and blasting (all operations)	Solid rock		39,300 cu.yd.	
	Other material		131,400 cu.yd.	
			170,700 cu.yd.	
Burley drills, labor		7,015.62		
Jap drills, labor		4,145.93		
Explosives		3,482.17		
Sharpening drills, labor		2,029.10		
Supplies		4,124.25		
Power		1,460.42		
Repairs		830.96		
Depreciation		1,341.83		
Preparatory expense		1,896.48	26,326.76	15.4c.
Total cost, all operations.	Solid rock		39,300 cu.yd.	
	Other material		131,400 cu.yd.	
			170,700 cu.yd.	
Steam shovel			29,045.77	Average cost per cu.yd.
Cableways, etc.			124,984.90	
Drilling and blasting			26,326.76	
Total			180,357.43	$1.06

NOTES:—Coal is charged to the work at $7.40 per ton.
Power is charged at 1½c. per kw.hr., plus a proper proportion of the cost of maintenance of the electrical installation, lights, etc.
Depreciation on equipment is figured at a rate that will charge off against the work about 75% of the cost of the equipment and the total cost of installation.
Labor, $2.40 per day of 8 hours.
Drill runners, $3.00 to $3.50.
Chuck tenders, $2.50 to $3.00.
Cableway operator, $4.00 to $5.00.
Drag-line engineers, $4.00 to $5.00.
Steam-shovel engineers, $150.00 per month.
Steam-shovel cranesman, $110.00 per month.
Derrick operator, $3.50 to $4.00.
Riggers, $3.00 to $4.00.

the period of active operations, and Table II is a detailed cost report of all operations.

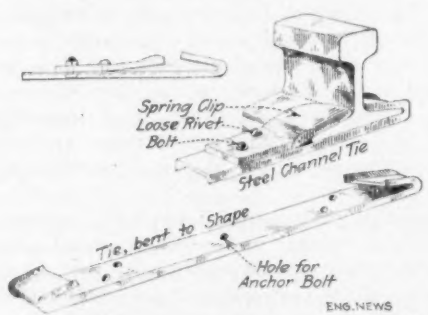
❖

A Steam Turbine of 40,000 hp. is to be erected in the Hagen electric power station, Westphalia, Germany, according to "The Engineer." The same authority states that this will be the largest steam turbine in the world, the present largest units being the two 30,000-hp. turbines of the Rhine Westphalia Co., at Düsseldorf.

Steel Channel Ties For Mine Tracks

A form of steel tie for mine tracks, which is now being introduced in the mines of the Pocahontas coal field, consists of a light channel having the ends bent back so as to fit over the outer side of the rail base. The fit is close enough to require the rail to be driven in with some force, thus insuring a tight grip on the rail base. On the inner side of the rail is a clamp held loosely by a rivet, so that it can be swung aside to allow the rail to be placed in position. The clamp is then driven back into line with the tie so that it grips the inner side of the rail base. A bolt can be fitted in the tail of the clamp, to keep it from working loose, but this is rarely used, as the clamp is slightly sprung when driven on the rail, so that it exerts a direct pressure and would require some force to displace it. At the middle of the tie is a hole for an anchor rod which is driven in the roadbed and prevents creeping of the track, but we are informed that this is not always necessary.

The channel is $2 \times \frac{9}{16}$ in., $\frac{3}{16}$ in. thick, weighing 1.76 lb. per ft., and is bent cold to shape in a machine specially designed for the purpose. A form of steel tie used somewhat extensively in these mines is made from a flat bar $1\frac{1}{2} \times \frac{1}{2}$ in., weighing 2.55 lb. per ft., but this is not so stiff as the channel of lighter weight. The price for the channels, however, is a little higher than that for the bars. For track of 44-in. gage the channel is 50½ in. long, and the two spring clamps are 6 in. long. Such a tie will weigh 9½ to 10 lb. complete.



STEEL CHANNEL TIE FOR MINE TRACKS, WITH SPRING CLIP FASTENINGS FOR THE RAILS

W. H. Coffman, Bluefield, W. Va.; Inventor.

A special advantage of the steel tie is its shallowness as compared with wood ties, and it is said that this is sufficient to enable 8 or 9% more coal to be carried in each car. It also enables the rails to have a bearing on the floor of the mine, so that track will keep in better surface than when the rails are unsupported between the ties. Under these conditions it is stated that the steel ties may be spaced 5 to 8 ft. apart, especially if the cars are not heavy and are operated by mules. Some of the steel ties, however, are used on tracks operated by electric motors. Separate short pieces of steel channels (not attached to the rails) may be placed longitudinally under the joints or at intermediate points.

These steel channel ties and the bending machine used in their manufacture are the invention of W. H. Coffman, Bluefield, W. Va., whose system of track construction for ordinary railways and street railways was described in our issue of Sept. 30, 1909.

Construction Work on the Idaho Northern Ry.

By J. H. Smith*

The work here described covers an extension of 103 miles of the Idaho Northern Ry., from Emmett north to Big Payette Lake, with terminus at McCall, Idaho. The principal traffic (which will move south) will consist of hay, grain and timber from Long Valley, and timber from the upper end of the cañon traversed by the line. The entire work was under the direction of the writer, with R. F. Hamilton as Office Engineer. The line was divided into 11 construction divisions, each under a division engineer.

General Features

For the first 63 miles the work is very heavy, the line being laid on the mountain side, following the Payette River. The remaining 40 miles is through the broad and fertile Long Valley. The greater part of the line holds to a grade of 0.7%, and a maximum curve of 10°;

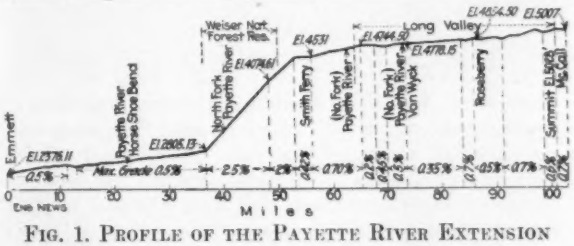


Fig. 1. Profile of the Payette River Extension of the Idaho Northern Ry.

about 16 miles, however, are on a pusher grade of 2.5% and 2%, compensated with 12° curves (Fig. 1). The compensation is at the rate of 0.03% per deg. on curves of 3° and less, and 0.04% per deg. on curves of more than 3°. The Searles transition spiral is used on curves of 2° and over. The total curvature is 9191° 11′, or an average of 89° 14′ per mile, and the aggregate length of curved track is 40.53 miles. The maximum grade against northbound traffic (which is the direction of light traffic) is 2.5%, while the maximum against the heavier southbound traffic is 0.7%. The total ascents aggregate 2846 ft., and the total descents 215 ft. The grading amounts to approximately 3,358,000 cu.yd., of which about 62% is rock.

There are four steel truss spans and eight girder spans, with a total length of 900 ft. In addition to this, there are about 4000 ft. of trestle, including pile and frame bents, and trestle decking on small concrete abutments. This last construction (with 20-ft. spans and ten stringers 8x17 in.) was used at points in the cañon where cloudbursts frequently occur; boulders carried across the line can only damage the deck, which can be repaired or replaced readily. There are four tunnels, aggregating 844 ft. in length. The original location had 1166 ft. of tunnel, but this was reduced by relocation. Two 2-stall engine-houses will be built; one at the foot of the 2.5% grade (for the accommodation of the pusher engines) and the other at the northern terminus.

Roadway and Track

The roadbed has a width, at subgrade, of 14 ft. on fills and 20 ft. in cuts. The slopes vary from ¼ on 1 to 1½ on 1, according to the materials encountered. The track is laid with 75-lb. rails of the Am. Soc. C. E. section, with Continuous joints. The ties are of Oregon fir, untreated, 7x8 in., 8 ft. long. Steel tie-plates are used on all curves of 2° or over, on all bridges and turnouts, and on track having a grade of 2% or over. The P. & M. boltless anti-creepers are installed on the 2.5% pusher grade. The track is ballasted with gravel obtained by widening cuts with the steam shovel.

Rails for curves of 4° and over were curved before laying. For this purpose, a roller rail-bender was mounted on a frame, and the rail drawn through it by a hoisting engine. The rails were curved in the material yard as they were received, and the curved rails piled so that they could be loaded readily in the order in which they were to go into the track. An average of about 200 rails per 10-hr. day was curved by this method, and a day's work reached as high as 312 rails in 10 hours.

The track work was done by company force. The first 50 miles of track was laid with a Harris tracklaying machine, and the balance with a McCabe & Steen machine. This latter resembles the Roberts steam tracklaying machine, with improvements added. In addition to the method used in carrying ties and rails to the front end of the pioneer car, the machine is provided with a device for turning the ties (as they leave the carrier) at right angles with the roadbed. These ties, after being handled in this manner, are held by an apron. After the requisite number of ties for a panel or rail length of track has been landed on the apron, the carrier can be stopped until the ties for the next panel are required. Four men are required to remove the ties, dropping and spacing them in advance of the pioneer car.

The method of handling rail is also a great improvement over old methods. As the rail passes forward through the carrier to the front end, tongs suspended by cable from the boom (operated by a pilot wheel at the front end of the car) are placed over the head of the rail. The rail is then lowered to proper position and heeled in against the previous rail. This operation requires four men to guide and heel the rail into the joint. The carriers are operated by steam furnished by the locomotive to an upright engine installed on the rear end of the pioneer car. To give some idea of the efficiency of this tracklayer, it may be noted that a ¼-mile stretch was laid on the Oregon Short Line branch, Nyssa to Homedale, without stopping the movement of the work train. Of course the conditions under which this was done were ideal.

Payette River Bridge

The bridge over the North Fork of the Payette River (Fig. 2) consists of two riveted truss spans of 139 ft. 2½ in., and four approach plate-girder deck spans of approximately 50 ft. The entire structure is on 2.5% grade. The small angle between bridge and stream, necessary to avoid curvature on the bridge, places the river pier at an angle of only 40° with the center line of bridge. The other piers being above normal water surface, are placed at 90° to the bridge. This condition produces the odd-looking short panel at the center pier (Fig. 2).

The piers and abutments are of plain concrete, except that the south abutment is of the reinforced-concrete buttressed type, with a short length of gravity

*Engineer, Idaho Northern Ry., Nampa, Idaho.

retaining wall. This is shown in Fig. 3. Excavation was all done by force account, and by hand in the dry except for the river pier. For the latter, a coffer-dam was formed with two rows of 3x10-in. sheet piling 10 ft. long, driven with a hand maul. As no good puddling material was available, sacks of earth and manure were dumped around the outside, but the coffer-dam was never completely unwatered. This was due to the absence of good puddling between the rows of sheet piling, to large boulders which forced the sheeting out of line, and to the porous character of the river bed, which admitted water underneath the sheeting. The gravel and sand

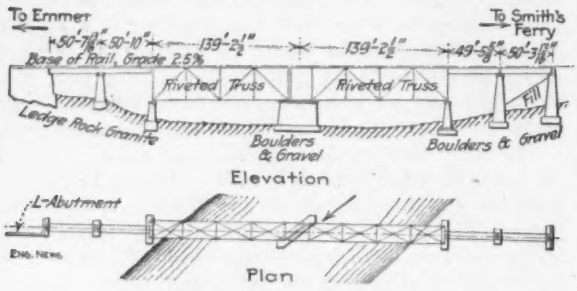


FIG. 2. BRIDGE OVER THE NORTH FORK OF THE PAYETTE RIVER

were removed by hand. Large boulders were shot and removed in a slip scraper, operated by a hand winch.

A concrete mixture of 1 : 2½ : 5 was used throughout, made with gravel obtained on the right-of-way about 12 miles below the site. The sand was obtained from the river bed about half a mile above the site, and was hauled in wagons to a bin near the south abutment. From this it was hauled in push cars to the mixer plant, this being done generally at night, to avoid being on the falsework deck during the day. The cement was furnished to the contractor by the railway company.

During concreting some extremely cold weather (as low as 20° below zero) was encountered. The sand and water were heated, and on a few very cold days the gravel was heated also. Water flowed continuously into a barrel near the mixer and into this barrel was led the exhaust pipe from the mixer engine and live steam from the boiler. This kept the water about as hot as the hand could stand. The sand was heated by a wood fire in a 36-in. iron culvert pipe about 20 ft. long, one end of the pipe being elevated about 6 ft. to give a draft. The gravel was heated by covering it with a tarpaulin and circulating live steam beneath. This method was used also for keeping the concrete warm after it was deposited. That no concrete was frozen, may be judged from the fact that after removal of the forms (at least five or six days after the heating was discontinued) the concrete felt warm to the hands.

The forms were of 1-in. dressed plank, doubled, with joints lapped; 2x6-in. studding 2 ft. apart, and 3x8-in. waling pieces 5 ft. apart. The 1-in. plank doubled makes a tight form, but is not as satisfactory otherwise as 2-in. tongued-and-grooved plank. The concrete for the lower foundation course was deposited under water by means of a tremie.

The falsework for temporary track and steel erection was timber trestling, the top story being a pony bent a little deeper than the permanent steelwork stringers, and resting on a cap which was slightly lower than the top chord of the steelwork. To carry the falsework over the skewed center pier, four old plate girders resting on skewed double bents were used, as may be seen in Fig. 4. The falsework in the river rested on rock-filled timber cribs. The bents were assembled in horizontal position on the cribs and were swung into position by a derrick car standing on the completed portion of the trestle (Fig. 5).

The steelwork was erected by company forces with derrick cars (as shown in Fig. 4), two cars being required to handle the heavier members. Most of the chord members extend over two panels, being about 65 ft. long. When all the main truss members and floor beams were placed, which could be done without moving any falsework, the stringers were set out on the long caps underneath the pony bents. The track for one stringer length was then torn up, the pony bents for that distance pulled over, stringers placed and track supports changed from false to permanent structures in a short time. The change thus took place a panel length at a time.

TUNNELS

Tunnel No. 1 (mile 33.6) is 467 ft. long, and is on a curve of 3° 26′. The heading was taken out first, followed by the bench 50 to 75 ft. back. The material in the east half of tunnel was lava (nonporous). In the west half it consisted of a coarse compact sandstone, the point of contact with the lava deposit giving a 10° angle with the horizontal. The neat section of tunnel gives 22 ft. 6 in. clear height on center line from base of rail; the clear width is 16 ft. at base of rail and springing. It was not necessary to line the tunnel during excavation, no water of consequence being found.

It was considered advisable to line the roof at both ends of the tunnel as a precaution against disintegration by weather. This is shown in Fig. 6. All lining consisted of sills, posts, plates and segments of 12x12-in. Oregon fir. The foundations are of concrete, the sills being anchored with ⅞x30-in. bolts, set 4 ft. apart. The lagging was 3x12 in. in 16-ft. lengths. Cedar packing was

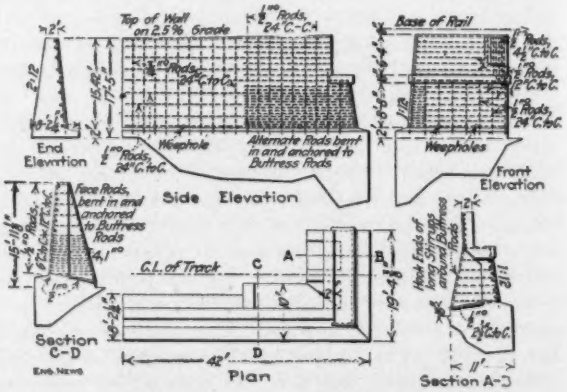


FIG. 3. L-SHAPED ABUTMENT OF PAYETTE RIVER BRIDGE: IDAHO NORTHERN RY.

used. No packing was used on the sides of the tunnel but if this should be found necessary later it can be put in readily without interfering with trains.

Tunnel No. 2 (mile 37.9) is 130 ft. long, on a 10° curve. More difficulty was experienced here, and it was

necessary to line it as it was being driven, owing to the columnar basalt formation (Fig. 7) which assumed an angle of 45° from the vertical. Tunnel No. 3 (mile 77) is 212 ft. long and is on a curve of 12°. The material was very seamy granite, which necessitated lining its entire length, as the tunnel was driven, to guard against falls of heavy blocks of stone.

Tunnel No. 4 (mile 84) is only 34 ft. long, and carries the line through a point of solid granite which rises sheer from the river to a height of 100 ft. above subgrade. As the river at this point is very narrow and must

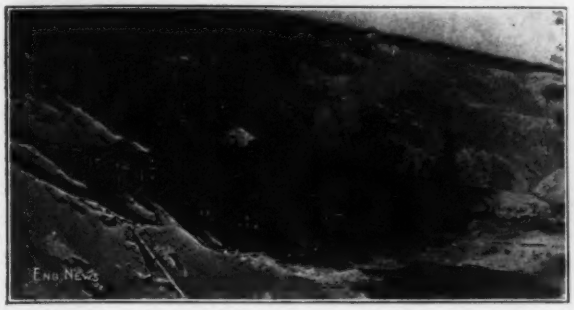


FIG. 4. TIMBER FALSEWORK, AND EQUIPMENT FOR ERECTING THE STEEL; PAYETTE RIVER BRIDGE

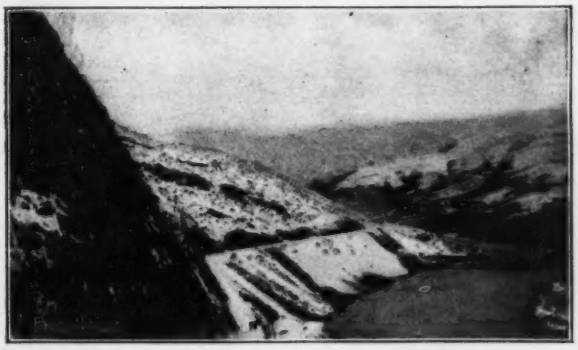


FIG. 7. CLIFF OF COLUMNAR BASALT FORMATION PIERCED BY TUNNEL NO. 2

be kept open for logging purposes, there was no place available for depositing material from an open cut. No lining was necessary.

CONSTRUCTION WORK

The Utah Construction Co., of Ogden, Utah, had the contract, and sublet the work in stretches of several hundred feet to station men. These gangs consisted of Swedes, Hungarians, Greeks, Italians, Spaniards and Mexicans, seldom any two nationalities mixing in work on the same station contract. For about 15 miles the line occupied a wagon trail in the cañon, and before construction of the roadbed could be started it was necessary to rebuild this road 100 to 300 ft. higher up the slope. Each subcontractor handled the stretch of highway opposite the limits of his work.

In loose materials, the grading was done by wheeled and fresno scrapers. In the basaltic lava formation, capped occasionally with a coarse gravel, the work was done by drilling and blasting, the material being removed by 1 to 1½-yd. dump cars on track of 2-ft. gage laid with 12-lb. rails. These cars were loaded by hand and hauled by horses and mules. For some miles the material encountered was granite in various stages of disintegration, and owing to its many seams and the varying hardness it was necessary to change the slope of excavation frequently. Some slides were encountered, due partly to springs and partly to the opening of seams carrying water from melting snows. Most of the slides were taken out as far back as they were broken loose, or reduced to a slope of 1 on 1½.

At a number of points in the cañon, it was necessary

FIG. 5. TRESTLE BENTS OF FALSEWORK READY TO BE RAISED INTO POSITION

FIG. 6. TIMBER LINING AT END OF ROCK TUNNEL NO. 1

FIG. 8. HEAVY SNOW ENCOUNTERED IN GRADING THE ROADBED; IDAHO NORTHERN RY.

to protect the embankments from erosion by the river. This was accomplished by building heavy dry walls of granite blocks of a size to require handling by derrick. These walls have a footing in trenches below low-water line, and they extend above high water on a slope of about 1½ on 1. The stone was taken from adjacent cuts.

Grading was begun on July 1, 1911, and completed Jan. 1, 1913. The work was considerably delayed during the winter of 1911-12 by heavy snow on the upper part of the line, as shown in Fig. 8.

An Eight-Hour Day for Workmen Employed by Contractors on state or municipal operations in New Jersey was provided for by the state legislature of 1913.

Floods and Levees at Cairo, Ill.

SYNOPSIS—Cairo is one of the most vulnerable points from a flood standpoint in the Mississippi Valley and is always one of the first heard from when the waters of the great river commence to rise. The following article describes the flood-protection work under way and in prospect there.

The city of Cairo (population 18,000) is at the extremity of a narrow peninsula between the Ohio and Mississippi rivers, the general land elevation of which is 12 to 18 ft. below maximum flood height. The levees surrounding the city vary in cross-section, being as much as 60 ft. in top width on Ohio St., and except for some very small portions they are occupied by two or more railway tracks. A stone and concrete wall is built along a mile of the Ohio River front, but otherwise the levee construction has not differed from that ordinarily used. The protected area in the city proper embraces about 1440 acres, protected by six miles of levees. The tops of these levees are 55 to 58 ft. on the river gage (the zero of which is 277.7 Memphis datum), but some few portions are below the minimum elevation.

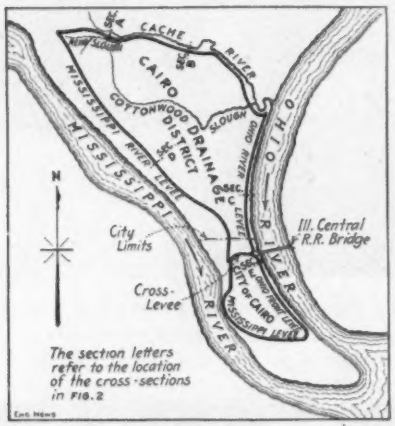


FIG. 1. MAP SHOWING THE LEVEE SYSTEM OF THE CAIRO DRAINAGE DISTRICT AND THE CITY OF CAIRO, ILL.

The Cairo Drainage District (6500 acres) is contiguous to the city and separated from it by the cross levee. This district has 15 miles of levee. The Cache River levee on the northern boundary (5.35 miles) has an 8-ft. crown, a land slope of 1 on 2 and a river slope of 1 on 3. Its height is from 6 to 11 ft. The levees along the Ohio (3.13 miles) and the Mississippi (6.15 miles) have an extra top width to accommodate the railways built upon them. The general situation is shown in Fig. 1.

During the flood of 1912, four breaks occurred, in addition to a few top washes which were easily repaired. The first break was in the Mississippi levee, the next two were in the Ohio levee and the fourth in the Cache levee. Only at the first two was there any scour below the bed of the levees. It was estimated that 70,000 cu.yd. of material would restore the levees to their normal section, and the Mississippi River Commission made a special appropriation of $45,000 towards this work.

PLANS FOR LEVEE IMPROVEMENTS: 1912

After the flood of 1912, it was evident that some improvements to the levee system must be made to prevent future disaster, and Charles H. Miller, of the Miller Engineering Co., Little Rock, Ark., was called in to investigate the situation and prepare plans for the improvement. The following is a description of the plans, but actual work had not been commenced at the time of the 1913 flood. Some minor modifications may now be made, but in general the plans as described apply to the work now proposed. We are indebted to Mr. Miller for information, drawings, etc., from which this article has been prepared.

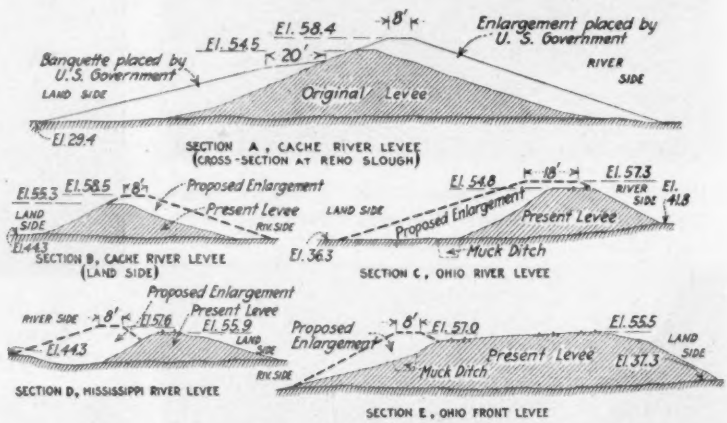


FIG. 2. CROSS-SECTIONS OF THE CAIRO LEVEES, SHOWING THE PROPOSED ENLARGEMENT

Appeals have been made to the State Legislature and the U. S. Government for additional aid in raising the Drainage District levees to a height of 60 ft. instead of 57 ft. on the government gage, as now planned. It is asserted that such aid is due from the U. S. Government, since its aid for levees in districts immediately below Cairo has resulted in confining the waters and raising the flood plane.

The plans proposed by Mr. Miller provide for raising the six miles of levees around the city to an elevation of 58 ft. on the government gage; and raising the levees of the Cairo drainage district to 57 ft., or 3 ft. above the flood level of 1912. These levees are shown on the map, Fig. 1, and the proposed enlargements of the levees are indicated by the cross-sections in Fig. 2. These provide for a top width of 8 ft., and along the Ohio and Mississippi levees muck ditches would be formed to cut off seepage at points where borings show the advisability of such precaution. It will be noticed that along the Ohio River front the enlargement and muck ditch are in part on the land side and in part on the water side of the levee. This is due to geological and other conditions. On the Mississippi River front, there would be practically a new bank outside of the existing levee, but it is probable that the latter would be raised also to the new elevation, thus forming one large bank.

The Cache River Levee protects the north end of the District, following closely the river of the same name. It has an 8-ft. crown, with river slope 3 to 1, and land slope 2 to 1 and a general average height varying from 6 ft. at the upper end to 11 ft. at the lower end. This is shown in sections *A* and *B*, Fig. 2. It will be raised, to conform with a stage of 57 ft. on the Cairo gage (an average raise of about 3½ ft.), and enlarged on the river side with 3 to 1 slope and have an 8-ft. crown. This is a simple levee enlargement proposition. The total estimated yardage, including repairs to breaks, is 321,000 cu.yd.

The Ohio River Levee, which protects the District on the east or Ohio River side, has an 18-ft. crown, upon which is located the C., C., C. & St. L. R.R. It has slopes that will average about 2 to 1, and a height of about 15 ft. It will be raised to conform with the 57-ft. stage (an average raise of about 3½ ft.), and enlarged on the land side with a 3 to 1 slope. A muck ditch 4 ft. deep will be placed at the toe of the present embankment or levee. The crown will be 18 ft. wide, so as to accommodate the railway track, which will be moved to the new position (section *C* in Fig. 2). But for the nearness of this line to the river bank, which prevents the possibility of getting a proper slope, the enlargement would be placed on the river side, thus obviating the necessity of raising the railway track. To place the enlargement on the land side and leave the railway track where it now is would result in separating the railway from the several industries which it serves.

Before raising the top of the present levee it will be necessary to first remove the ballast which is now under the track. Other complications have been encountered. In one case, an industry is located close to the levee and has expensive machinery set within the limits of the proposed enlargement; here a concrete retaining wall will be used. At the Ohio River bridge, the head room for the track on the levee (passing under the bridge) is such that the track cannot be raised a sufficient amount. Hence the levee enlargement must be set over and extended along the Illinois Central R.R. track far enough to permit of a proper runoff so that the tracks under the bridge need not be raised.

The estimated yardage for the Ohio River levee, including repairs to breaks, amounts to 372,600 cu.yd. Because of the impracticability of securing necessary right-of-way at the site, all of the material must be hauled in by rail.

The Mississippi River Levee protects the District on the west side. It has an 18-ft. crown upon which is located the Mobile & Ohio Ry. track. The slope will average about 2½ to 1 and it has a height varying from about 8 ft. to 18 ft. It will be raised to conform with the same gage height as the others and enlarged on the river side with 3 to 1 slope, the crown to be 18 ft. and the railway track to be moved up to the new grade (Section *D* in Fig. 2). It would be preferable from the levee point of view to separate the railway from the levee by placing all of the enlargement in front of the present embankment, but such an arrangement did not meet with the approval of the railway officials.

On account of the nearness of the Iron Mountain Ry. track to the west or river side of this levee it will be impossible to get more than 25% of the necessity material at the site. The balance will have to be hauled in by rail, which process is the more expensive because most of the material must be rehandled with teams in order to get it out to the proper slope, etc. The estimated yardage required, including repairs to the break, amounts to 300,000 cu.yd.

In the enlargement of the levees around the city of Cairo proper a number of unusual conditions are encountered. This, however, applies mainly to the Ohio River front; because practically all of the line along the Mississippi River front, which is now occupied by the double track of the Mobile & Ohio Ry., is above the proposed grade of 57 ft. The "cross levee" between the city and the Drainage District, composed in large part of the embankment approach to the Ohio River bridge, is also at or above the adopted grade.

On the Ohio River front and for a distance downstream from the Ohio River bridge of about 1¼ miles, or to the upper end of the concrete wall, the work (except around the Cairo elevator) will be ordinary enlargement, placed, however, under one or more side tracks which will be raised where necessary. In addition, a muck ditch will be required because of a layer of cinders now located about 4 or 5 ft. below the present surface of the levee. This is shown in Section *E*, Fig. 2. All of the front slope, being in a position exposed to wave wash, will have to be paved with riprap or reinforced concrete about 4 in. thick.

Reinforcing the River-Front Wall

On the Ohio River front of the city is a river wall extending from 2d to 18th Sts., and this will be raised and strengthened as shown in Fig. 3. A line of inclined sheet piling (of steel, concrete or creosoted wood) will be driven to cut off the sandy strata through which seepage occurs, and upon this piling will be built the footing of a reinforced-concrete slope wall, bonded into the existing wall of rubble masonry. This will be carried up about 2½ ft. above the top of the present wall. At the wharf, where the river bank is paved, the sheet piling will be omitted, as shown by the smaller section in Fig. 3 on following page.

Along this concrete wall, which is practically a mile in length, two defects must be overcome. One is that the top width is not sufficient to permit of placing upon it the necessary additional height to reach the new grade line. The other is the porous condition of the foundation upon which the concrete rests, part of it being a loose rubble wall. This condition as it now exists has come about through the process of addition from time to time; while the railway company filled in behind the wall as it was built up, using such material as is ordinarily available around a terminal, and which is composed in large part of cinders. Hence under the present conditions much seepage must be contended with as soon as the river gets above the level of the top of the street immediately behind the wall.

To overcome these defects the present plan contemplates the placing of what may be termed a curtain wall, or covering 1 ft. thick, built of reinforced concrete (Fig. 3). Its bottom will be in all cases below the general level of the low ground in the city, and in one stretch of 1400 lin.ft., where much sand is encountered, the bottom will be 33 ft. below the street level. This curtain wall is to be carried up to the top, the reinforcement to be tied into the present wall, and the whole placed so

as to get the necessary topping all incorporated into one structure. The top width will be left at about 3 ft., so as to permit of future topping without much extra expense. The concrete required for this wall proper will be about 7000 cu.yd. The total estimated cost of the entire work is $648,000, distributed as follows: U. S. Government, $250,000; railways, $220,000; Cairo Drainage District, $128,000, City of Cairo, $50,000.

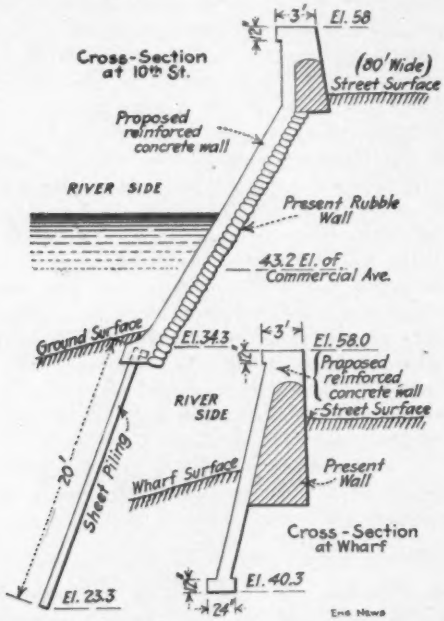


FIG. 3. CROSS-SECTION OF THE PROPOSED REINFORCEMENT OF THE RIVER FRONT WALL AT CAIRO, ILL.

THE 1913 FLOOD AND FLOOD-PROTECTION WORK

From the 43.5-ft. stage on Mar. 26, the river rose steadily at Cairo till it reached a maximum of 54.8 ft. about noon on Apr. 4. This was 0.8 ft. higher than the flood of 1912, which had exceeded all previous records by nearly 2 ft. A remarkable feature of the flood was the unprecedented rate of increase in rise, which was from 1 ft. to 2 ft. per 24 hr. from the time the river passed the 44-ft. mark and until the breaks occurred in the levees in the immediate vicinity. The first break in the levees of the Cairo Drainage District occurred about 6 p.m., Apr. 1.

During the last days of March, the Ohio River was rising at the rate of nearly 2 ft. in 24 hours, even after the 50-ft. stage had been reached. It was predicted that it would rise to such a stage as to overtop the levees in places, and it was advised that women and children should be got out of the city. The labor situation was very acute. The labor market in many cities had been depleted by the drafts for the flooded districts in Ohio and Indiana, while many able-bodied men left the city. Merchants were paying high prices (as high as $3.50 per day) for labor necessary to assist in moving supplies and goods to the second floors. The railways were offering as much as $2.50 per day, while their agents were scouring Chicago and other cities for labor. The police force at Cairo was trying to drive the local labor to the levee work, the men hiding in their homes in the belief that if the overflow came they would be cared for by the U. S. Government and would not have to work.

The engineer in charge of the flood protection work had gangs of 10 men where he needed gangs of 100 men. When he reported that the Cairo Drainage District (6500 acres) would have to be abandoned, and a much greater supply of labor secured at once in order to save the city from inundation, the Governor of Illinois was requested (by long-distance telephone) to send 200 of the state troops (Illinois National Guard) for guard duty and 1000 laborers. His reply was that as he could not get any laborers he would send the 7th Regiment, 700 strong, in addition to 200 of the 4th Regiment already ordered out, with instructions to do any kind of work that was to be done.

Coincident with the arrival of the troops, the mayor issued a proclamation closing all factories and places of business, and calling upon all able-bodied men to report for duty. This, together with the use of the troops to assist in bringing out all labor that was in hiding, cleared up the situation so that the troops (except a local company which worked all the time) were not required to do regular manual labor after the first day or two. It is thought that if this amount of labor had been available four days earlier, the flooding of the drainage district could have been prevented.

In regard to the valuable assistance rendered by the troops, Mr. Miller (who had charge of the fight against the high water) has reported as follows:

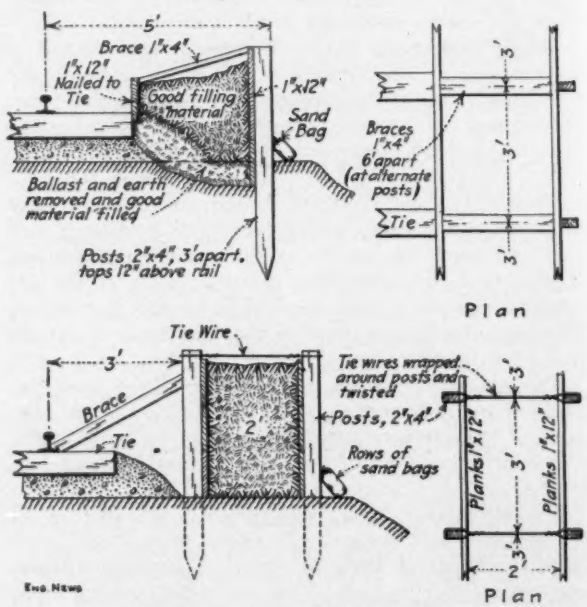


FIG. 4. BULKHEADS OF PLANK AND EARTH CONSTRUCTION USED TO RAISE THE CAIRO CITY LEVEES DURING THE FLOOD

These men, among whom could be found lawyers, physicians, consulting engineers, and high-priced mechanics, went to work at once, doing what they were told to do, whether it was shoveling dirt, building bulkheads or carrying sacks. A number were detailed with the police force to get out every idle negro laborer and they got more than could be used, thus relieving the troops from further manual labor after the first day or two.

Too much cannot be said for these men who, having no local interest, worked side by side with the citizens because they had been taught to obey instructions. Instead of panic, confidence soon reigned, and the protective works soon got far enough ahead of the rising water to stop the reports (which were constantly coming to headquarters) that water was running over the levee. With plenty of materials on hand and 1000 extra men ready and willing to jump into any emergency when directed there was hardly a chance of failure Without these troops, no one would have been willing to say that loss of life and property would not have occurred. No one but the engineer who has had trouble with labor strikes can understand the feeling of security that exists when backed by a body of men having the training that carries with it concentrated team work when demanded.

The flood-service work was under the supervision of committees organized by the local authorities, very much as during the flood of 1912. The Executive Committee was headed by the mayor, and the other committees were as follows: (1) labor; (2) railways; (3) purchases; (4) commissary; (5) patrol; (6) automobiles and conveyances; (7) subway. This last had to deal with the closing of a subway through the cross levee separating the city from the drainage district. It was closed with a timber bulkhead backed by sand-bags. The city has the advantage of having railways on nearly all the levees, while telephone boxes were erected at ½-mile intervals and electric lights at frequent intervals along the city's levees.

FIG. 5. THE RIVER FRONT AT CAIRO, ILL., SHOWING PLANK AND EARTH BULKHEAD WALL

Charts were kept at the central office, showing the distribution of forces at all times. Hourly reports were made by the heads of committees, the patrolmen on the levees, and the foremen of the working gangs. In this way, every new emergency or point of danger was promptly known and attended to. Record was kept also of all materials and equipment. Switch engines were kept ready for use, and cars loaded with sand-bags were on sidings in different parts of the city, while tugs and barges loaded with stone were also held in readiness.

The railways had to operate extra equipment on account of the great number of persons leaving the city (over 5000 in three days), and effective work on 2½ miles of the levee (occupied by the railways) had to be suspended for four or five hours daily on account of the trains. This could have been avoided by abandoning the operations of tracks through the city and requiring passengers to take train at the city limits.

BULKHEAD FLOOD WALLS

The use of bulkheads for raising the embankment was adopted as being more economical and expeditious than the use of sacks filled with earth, and allowing less water to come through. The methods of bulkheading along the railway tracks are shown in Fig. 4. The left-hand drawing shows the method used along railway tracks where the bank was comparatively narrow and where it was not necessary to carry it up much above the rails. Where a greater height was required, the bulkhead had to be at a greater distance from the track so as to clear the cars, and where the height was 2 ft. or more knee-braces were placed, as shown in the right-hand drawing. This latter design was used also where there were no tracks. In cases where wave wash was expected, a row of sacks was placed along the bottom of the outer face of the bulkhead. With railway facilities this bulkhead construction can be pushed very rapidly. One stretch of 1½ miles, averaging 3 ft. in height, was completed in five hours, except that not all of the earth had been filled in.

At one point a special outer bulkhead was built to resist wave action when the Weather Bureau predicted very high east winds. This was beyond the regular bulkhead, and was braced from the latter, besides being weighted with sand-bags on top.

Fig. 5 shows the main plank and earth bulkhead along the Ohio River front. Outside of this is the top of a sand-bag bulkhead started by the Illinois Central R.R. When it was seen that the railway company could not continue the fight here on account of the scarcity of labor, the city undertook the work, and built the plank and earth bulkhead. Fig. 6 shows a special bulkhead across a street opening in the concrete river-wall (see Fig. 1). The water rose 5 ft. against this bulkhead.

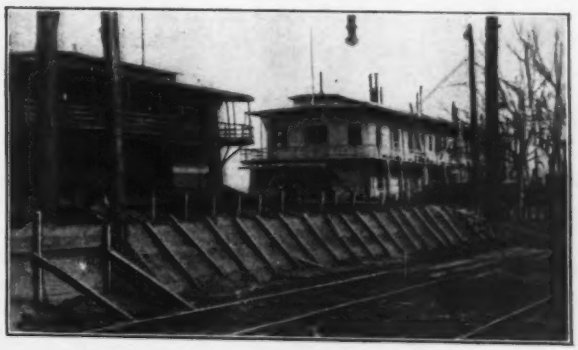


FIG. 6. SPECIAL BULKHEAD WALL TO CLOSE A STREET OPENING IN THE RIVER WALL

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Phosphate Resources of the United States are stated in a forthcoming Census Bulletin to be superior to those of any other country. The Bureau of Soils of the Department of Agriculture gives what are regarded as ultraconservative estimates of the quantity of available phosphate rock in 1911 in the different parts of the country as follows: Utah, Idaho, Wyoming and Montana, high grade, 2,500,000,000 tons; high-grade equivalent of low grade, 6,667,000,000 tons; Tennessee, high-grade equivalent of all grades, 160,000,000 tons; South Carolina, high-grade equivalent of all grades, 3,000,000 tons; Arkansas, high-grade equivalent of all grades, 20,000,000 tons; Florida, high-grade equivalent of all grades, 150,000,000 tons; Florida, high-grade equivalent of wash heaps, 16,000,000 tons. Thus the amount of high-grade rock and its equivalent in lower grades is estimated at over 9,500,000,000 tons. As the quantity marketed annually in the United States does not exceed 2,655,000 tons it is evident that the available supply should be adequate for many centuries.

The Service Equipment of the Samaritan Hospital, Troy, N. Y.

By C. F. Herington*

The Samaritan Hospital, which will rank as one of the most uptodate buildings of its class in the country, was recently started in the city of Troy, N. Y. It is being built from plans prepared by Geo. B. Post & Sons, Architects, of New York City, associated with Richard D. Kimball Co., Engineers, of New York and Boston, and with Dr. S. S. Goldwater, Superintendent of Mount Sinai Hospital, New York City, as adviser on hospital arrangement and equipment. The service equipment is here breifly noted for a single building of this group (Male Ward Service, House Staff and Kitchen Building) as a notable instance of advanced practice in heating and ventilation systems.

*3 West 29th St., New York City.

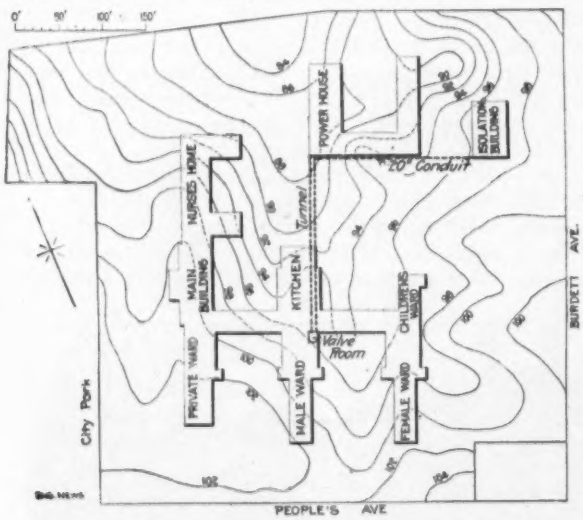


Fig. 1. Plan of Samaritan Hospital Group, Troy, N. Y.

The buildings are heated with engine exhaust in a vacuum system with direct radiation in all rooms; fan systems with the tempering and heating coils are provided for supplying fresh air to the male and female ward buildings and the operating rooms. Exhaust fans are installed for the ventilation of all buildings. The fresh-air fans for the male and female wards and the exhaust fans for the wards are to be installed in the future and not at first. Light and power, hot water and steam are furnished from the engine and boiler rooms in one building of the group.

Service Plant

Steam Supply—The steam supply is furnished at 125 lb. gage pressure by three horizontal return-tube boilers with a heating surface of 1527 sq.ft. The grates are 6 ft. wide and 6 ft. 6 in. long. A high-pressure damper regulator operates all the dampers in the boiler uptakes by means of a rod running across the uptakes. The boilers are covered with narrow wood strips ¾ in. thick, laid a slight distance apart from each other. On top of these is laid a course of brick with thin cement-mortar joints, which joints were flushed, and a 2-in. coat of cement mortar placed on top.

A closed feed-water heater of the horizontal pattern is used.

There are two single-cylinder boiler feed pumps with a receiver, which is vented to the roof with 2-in. pipe. There are also two brass-lined vacuum pumps capable of handling all the condensate, discharging into an air separating tank. Two duplicates of the boiler-feed pumps (but without receivers) are installed for hot water circulation.

There is a 24x48-in. cast-iron blowoff tank with a 2½-in. sewer connection and a 2½-in. vapor pipe to roof.

To deaden the noise of the exhaust from the engines, when necessary to discharge into the air, a muffler tank

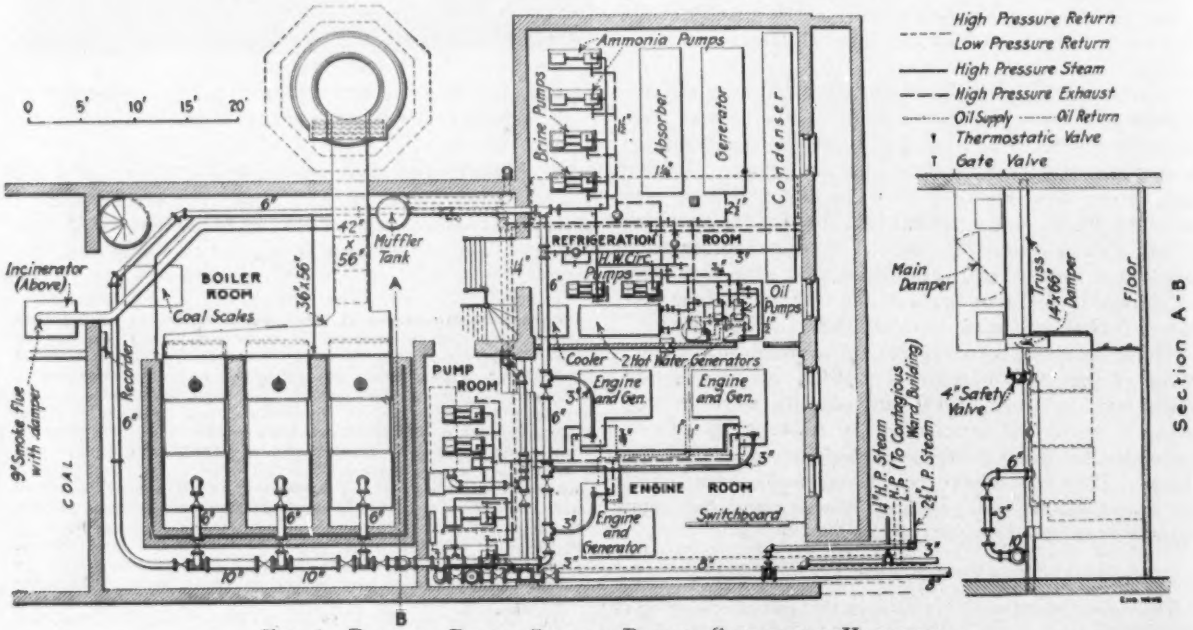
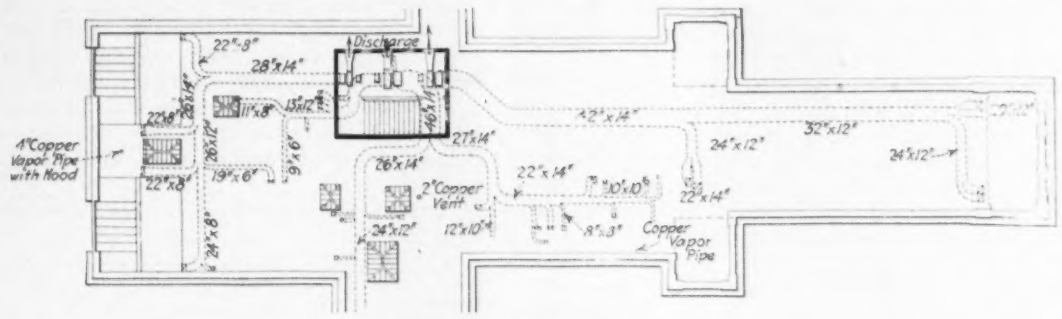
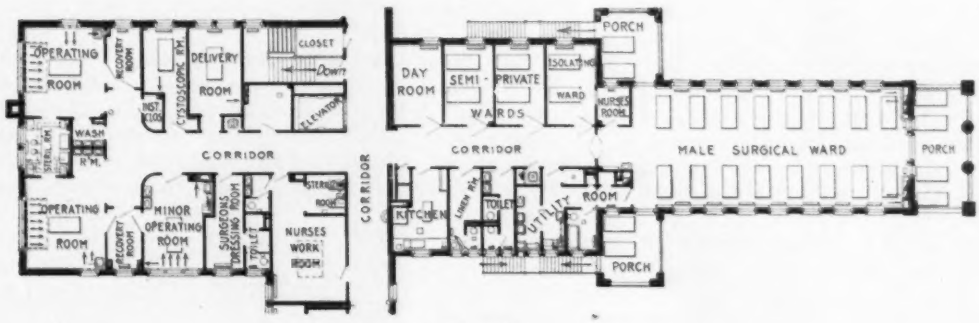


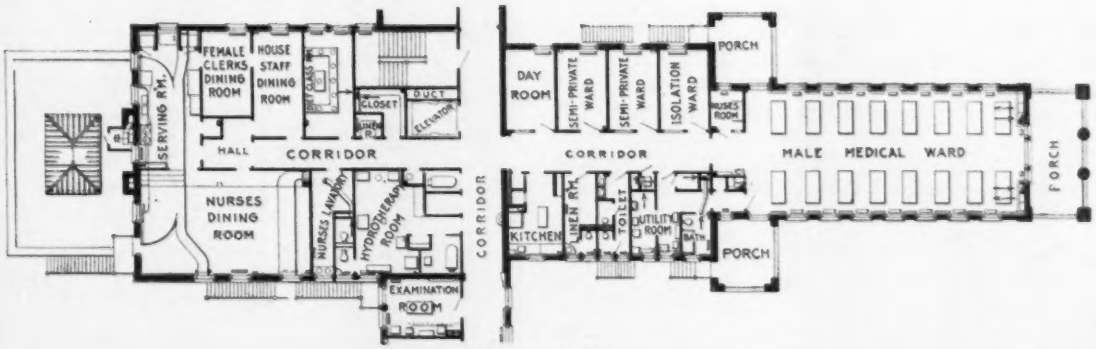
Fig. 2. Plan of Power Service Plant; Samaritan Hospital



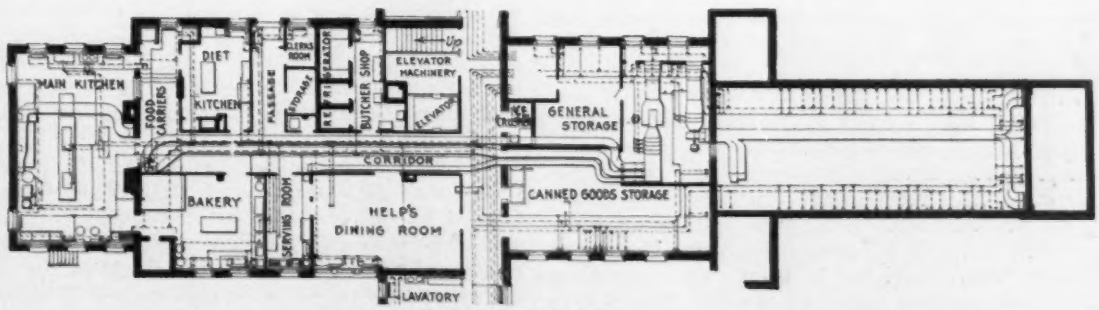
ROOF PLAN



SECOND FLOOR



FIRST FLOOR



BASEMENT

SAMARITAN HOSPITAL, TROY, NEW YORK.

MALE WARD, SERVICE, HOUSE STAFF AND KITCHEN BUILDING

Eng. News

36x48 in. is used, made of ¼-in. steel with ⅜-in. heads and inclosing baffle plates.

Three vertical steam separators are used with a ¾-in. drip leading to a 1-in. trap and thence to the receiver. The oil extractor is a vertical upcurrent pattern with a water glass and a 1-in. drip to the blowoff tank. One 2-in. double-filtration multiple-cartridge type of feed-water filter is provided, having a capacity for 350 hp. of boilers. A Venturi meter is installed in the feed-water line and a hot-and-cold-water meter is installed for measuring the makeup feed water.

Two hot-water service tanks are installed (39 in. in diameter and 96 in. long). These tanks are set one over the other and have steam heating coils with a gate valve on the steam supply and a gate and check on the steam return. Each tank is equipped with a hot-water regulator valve in the steam supply.

A vapor condenser is located in the suction pipe leading from the vacuum return headers to the vacuum pumps, and has a capacity equal to 30,000 sq.ft. of direct radiation. The cold-water connections to the hot-water generators are made through this condenser. High-pressure steam is piped to the kitchen, laundry, sterilizing and operating rooms.

The pressure-reducing valves used are of the low-pressure, lever pattern, flanged and bypassed. The reducing valve for the laundry lowers the steam pressure to 85 lb. while the one for the kitchen, etc., reduces to 40 lb. The back-pressure valve in the exhaust is installed with a lever and graduated weights so as to maintain a pressure up to 4 lb.

ENGINES—There are three engines of a simple single-cylinder type. Two have 9-in. cylinders with a 9-in. stroke, and run at about 310 r.p.m., direct connected to 125-250-volt, direct-current, three-wire generators of 25 kw. capacity. The third engine has a 11½-in. cylinder and a 12-in. stroke and runs at 290 r.p.m., connected to a 50-kw. generator.

EQUIPMENT

DIRECT RADIATION—Each direct radiator, coil or heater (except radiators which are automatically controlled) has on its supply connection which is made at the top of the radiator a graduated control valve contaning an auxiliary stop-off valve and every radiator, coil and heater together with the hot-water heater, has on its return connection a combination air- and water-relief float valve.

Wherever pipes pass through the floors or partitions a space of at least 1 in. is left between the woodwork and the piping, and the woodwork near the pipes is also protected by tin, galvanized iron or asbestos. Where risers or other pipes pass through the floors or partitions they are protected through the full depth of the flooring or partition with adjustable metal pipe sleeves one size larger than the pipe. At points where the pipes pass through masonry walls wrought-iron pipe sleeves two sizes larger than the pipe are used.

The steam pipes are carefully pitched about 1 in. in 10 ft. and the return pipes, branches and runouts are graded 1 in. in 8 ft. Where the return pipes are run in the floor 16-gage galvanized-iron strips are placed under the pipes with inverted-U protecting arches placed above.

Steam and return connections are made to the laundry, kitchen, diet kitchen, sterilizing, drying, warming apparatus, and steam bath apparatus. The branches from the mains to the risers and the radiators are run beside the walls or partitions, as far as possible.

Each steam riser has a valve located in the basement with a right-and-left coupling placed just above the valve. All risers in the wards are concealed and covered but elsewhere are run exposed. The steam mains and risers are dripped with ½-in. drips which are connected to the return pipe through motor-seal valves and strainers.

The radiator connections are of the following pipe sizes:

40 sq.ft. of surface or less	1-in. runout and ¾-in. valve on supply ¾-in. runout and ½-in. valve on return
Above 40 sq.ft. of surface	1¼-in. runout and 1-in. valve on supply ¾-in. runout and ½-in. valve on return

Runouts of over 5 ft. in length are made one size larger than the above but keep the same size radiator valve.

The steam mains for the laundry, kitchen and sterilizing work are entirely separated from those of the heating system and are valved so as to operate independently.

RADIATORS—The direct radiators in general are a plain pattern hot-water hospital style, and are hung 4 in. from the wall and 5 in. above the floor except on the

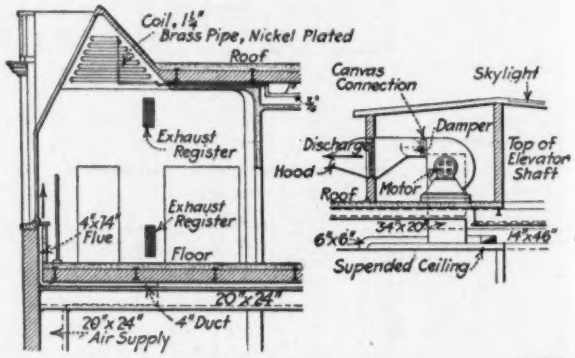


FIG. 4. DETAILS OF EXHAUST VENTILATION AND OPERATING-ROOM HEATING; SAMARITAN HOSPITAL GROUP

end wall of the auditorium, where the bottoms are 15 in. above the floor. The wall radiators are erected with the usual hooks and are finished to match the finish of the rooms. The pipe coils on the walls and ceiling are of straight lengths of pipe connected by branch tees and fittings. Graduating valves are used on the supply, and water-seal valves on the return connections of all coils.

Nickel-plated brass coils are used in the operating rooms, with all connections of nickel-plated brass, and hung 3 in. out from the wall. Bed-pan warmers are used of white metal, with white-metal globe valves on the supply and white-metal globes and checks on the return.

DRYING CLOSETS—In each drying closet is installed a warming coil of 1-in. iron pipe with a gate valve on the supply and a gate and check valve on the return with a wire-mesh guard set in a channel iron frame to keep the blankets from touching the pipes.

AUTOMATIC TEMPERATURE CONTROL—A system of automatic temperature control is installed as follows:

Two female wards	4 thermostats	32 valves
Two children's wards	4 thermostats	18 valves
Two male wards	4 thermostats	32 valves
Three operating rooms	3 thermostats	3 double dampers
On blast coils	12 duct thermostats	14 valves

The thermostats control the double or mixing dampers in the ducts which supply warm air to the operating rooms, or the valves on the radiators in the other rooms. The radiators under thermostatic control are equipped with diaphragm valves. The thermostats are all of the graduating type. The compressed air required for the operation of the control system is supplied by two air compressors run with water pressure and feeding into an air-storage tank.

PIPE COVERING—The steam pipes and high-pressure return pipes are covered with sectional insulation. The low-pressure pipes and all drips are covered with 1-in. cellular lagging, while the steam pipes in the boiler, pump, engine and apparatus rooms are covered 1½ in. thick. All concealed risers are insulated with concrete cellular sectional covering ¾ in. in thickness.

The fresh air ducts from the heater in the basement to the operating rooms are covered with ½-in. vitrified cellular sheets finished with ½-in. asbestos-cement felting with a hard and smooth surface. To all sectional pipe coverings, exposed in finished rooms, is applied an 8-oz. canvas jacket, with an asbestos-paper lining, sewed on; sectional covering not so exposed is finished with 6-oz. canvas and metal bands.

The smoke flue and uptakes of the boilers are covered with 1-in. cellular blocks, wired on, over which is applied 1 in. of asbestos-cement felting, also wired on and given a hard plaster finish. This covering is kept 1 in. away from the metal by a ½-in. wire mesh supported on 1-in. nipples spaced four to the square foot.

The feed-water heater is covered with 1-in. cellular blocks, wired on, over which is 1 in. of asbestos cement with a hard, smooth finish. The hot-water generators are covered with 1-in. cellular blocks, wired on, over which is 1 in. of asbestos-cement felting, also wired on and finished hard and smooth. The separators and extractor are covered with 1½ in. of asbestos-cement felting, wired on, finished hard and smooth and covered with canvas.

The feed-water heater and hot-water boilers carry 1-in. cellular blocks, wired on, with another inch of asbestos cement given a hard surface finish. The steam separator and oil extractor have 1½ in. of asbestos felt hard finished and canvas covered.

INDIRECT HEATING—There are in all 13 fans installed to operate the various indirect heating and the exhaust systems. These are all motor-driven, being connected by flexible couplings. The blast coils consist of three separate heaters. The first consists of two groups each of seven sections per group and a total heating surface of 150 sq.ft., for the tempering coil, and four groups of seven sections each with 301 sq.ft. of heating surface, for the reheaters. The second heater consists of two groups of seven sections, each with a total of 150 sq.ft. of heating surface, for the tempering coil and a similar coil for the reheater. The third consists of two groups of nine sections each with a total of 193 sq.ft. of heating surface for the tempering coils and a similar coil for the reheater. These heaters are all of cast iron, with separate valves for each group on both the steam and return connections; each section is separately valved so as to allow the use of as many sections as desired. The heaters are inclosed in a 16-gage sheet-steel casing stiffened with 1¼-in. angles and sheet-metal connection are extended between the heaters, air washers and fans.

The fan inlets and outlets are connected to the ducts by 10-oz. double-canvas sleeves 8 in. long, painted with four coats of lead-and-oil paint.

Diffusers and deflectors are liberally used, especially back of the outlet and inlet openings near the grill and register faces.

The dampers in the ducts are all of the pan type, those of large size being counterweighted and hung on roller bearings with tension springs. Deflectors are placed at all points where the branch ducts leave the main duct and are adjustable from the outside through handhole openings.

The exhaust ducts in the attic or roof space where run from one building to another are provided with fire dampers held open with fusible links so as to close automatically in case of fire.

Register faces are fastened to wooden frames and grounds or to cast-iron wall boxes. All vertical registers have the faces hinged and provided with catches. The register faces are of plain lattice design and are finished in white enamel where placed in the plaster and in bronze where placed in the woodwork. All the cold-air inlets and discharge-fan openings have heavy louvres and screens.

AIR WASHERS—The air washers, of which there are three, have a capacity of 3300, 4000 and 5000 cu.ft. per min. respectively, with the velocity of the air going through the washer not exceeding 500 ft. per min. These washers are constructed of No. 18 gage galvanized iron with settling tanks 16 in. high and of No. 16 gage galvanized iron extending under the entire washer.

In the side of each washer casing is a cast-iron access door with three glass panels about 9x12 in. The door closes against a rubber gasket on the door frame. The spray nozzles are evenly spaced over the cross-section of the washer and are arranged so that the entire interior of the washer between the nozzles and eliminator plates is uniformly filled with fine spray. The eliminators are set vertically in position and are of No. 24 gage galvanized iron. They are arranged so that the first three constitute a washing surface.

Effect of Chestnut Blight on Timber—The inroads of the chestnut-bark disease, or chestnut blight, on the chestnut trees of New England and the Middle Atlantic States is resulting in the death of a great deal of chestnut timber. Officials of the U. S. Department of Agriculture recommend, to prevent the spread of the disease, that shipments of chestnut timber should include only material from which the bark has been removed and from which the diseased spots have been cut out.

In the region affected there is a good market for all chestnut products except cordwood. The demand for poles and ties absorbs all that are offered, and lumber finds ready sale in local markets. Cordwood, however, is often a drug except within shipping distance of tanning-extract plants, brass foundries, lime kilns, brick yards and charcoal plants.

The question has arisen as to whether the disease-killed timber is less valuable than that from green trees. Strength tests made by the U. S. Forest Service indicate that sound wood from chestnut killed by the bark disease is as strong as that from green timber.

The bark disease kills the tree by girdling the trunk, and does not cause unsound or decayed wood, which is the result of attack by fungi or insects. Until two years after the death of the tree the wood generally remains sound, though at the end of that time insects have commenced working in the sapwood. Three years after death the sapwood is honeycombed with insect burrows; in four years it has decayed, and begins to dry and peel off in the fifth year. After this the heartwood checks badly. To avoid loss, therefore, all timber should be used within two years after being killed.—From a Bulletin of the U. S. Forest Service.

Plain Concrete Paving Used in Kansas City, Mo.

By Clark R. Mandigo*

SYNOPSIS—More concrete paving for city streets has been laid in Kansas City, Mo., than in any city in the country. The following article by the Assistant City Engineer describes the construction of these pavements and comments upon their wear and utility. In general, he is impressed with the high value of the concrete pavement, but sounds a word of caution as to its use under all conditions and in all circumstances.

During recent years the use of portland-cement concrete paving has increased enormously. The demand for good roads, decreased cost of cement, and a fuller knowledge of the material, have all contributed to this growth. From use as a paving for country roads, alleys and side streets, concrete paving has even been placed in competition with brick and asphalt on some of the principal streets in large cities. In an attempt to meet these severe conditions some engineers have advocated a concrete pavement constructed in a manner similar to a macadam pavement, some like a granitoid sidewalk, others similar to a reinforced-concrete floor slab, others like the foundation to a brick or asphalt pavement. Consequently, any record of the experience of a municipality, which has used a particular form of concrete paving, should be of value in standardizing practice and in obtaining the best and most economical construction for the kind of service required.

Fig. 1. Constructing a Concrete Pavement in Kansas City, Mo.

(This view shows the construction under the latest specifications and it illustrates the method of hauling the concrete, the use of the hoe and bent shovel for grading concrete, the tamp and the men working to shape up the surface with the back of the push broom. After fresh concrete takes the initial set, another man with broom, who is working behind the camera, puts the finishing touches to the pavement with the fiber push broom. This contractor averaged 1000 sq.yd. per day and moved his mixer every two blocks. The pavement is 26 ft. wide.)

Early Construction—Kansas City, Mo., has used almost exclusively the form of concrete constructed like the concrete foundation for a brick or asphalt pavement—a plain, one-course concrete. Two years ago a small amount of two-course float-finished pavement was constructed, but the pavement was not as satisfactory as the cheaper one-course pavement and no more has been laid.

Alleys—The first concrete pavement laid in Kansas City was in an alley and was completed in April, 1907. The specifications called for 6 in. of 1:3:5 concrete tamped and flushed to a true plane. The contract price, including a guarantee of seven years, was $1.23 per sq. yd. Although located in a residence district gradually changing to business, there has never been any need of repairs on this pavement. No expansion joints were provided and no serious cracks have ever developed. Since 1907 a great many alleys have been paved with concrete under practically the same specifications with uniform success so that on Jan. 1, 1913, there were 7.5 miles of concrete alleys in Kansas City.

Sixth St. Paving—In the Fall of 1910, it became necessary to provide a surfacing for Sixth St. from Broadway to Bluff St. This street is an important connecting link between the railroad and warehouse district and the uptown wholesale and retail district. Proceedings had been started to widen the street and it was expected that whatever pavement was laid would be of a temporary nature until the proposed wider roadway could be paved with granite or wood blocks. A contract was accordingly let for paving this street with concrete 6 in. thick and mixed 1:2½:4½; the contractor being allowed to use the broken and screened old foundation as aggregate in his concrete. The pavement was laid in November and every effort made to hurry its completion before cold weather (see Fig. 2). No joints of any kind were provided. The finished concrete was covered with manure and allowed to set for two weeks before being thrown open to traffic, during which time the temperature dropped to several degrees below freezing every night.

In the winter months following, transverse cracks appeared at intervals of about 125 ft., but these have never given any trouble. The pavement also seemed to have been affected by frost, but no general defects appeared in the first few months of use below a depth of ¼ in. After six or eight months' wear, portions of the pavement

*Assistant City Engineer, Kansas City, Mo.

developed "chug-holes." These occurred, probably, where there were rock pockets in the concrete or where the broken concrete used as aggregate made an uneven mixture. The east block of paving on which a continuous mixer and freshly broken stone were used, has worn

FIG. 2. VIEW OF SURFACE OF CONCRETE PAVEMENT ON SIXTH ST., KANSAS CITY, LAID IN 1910 AND SUBJECTED TO VERY HEAVY WEAR

remarkably uniformly and with few holes. The west two blocks were resurfaced with from 4 to 5 in. of concrete in May, 1912, while the whole street was again closed for repairs early in 1913. Other repairs have been necessary from time to time. The original concrete on the east end is still in use after 2½ years of heavy traffic.

A census of the traffic passing over this street between 6 a.m. and 6 p.m., during three consecutive days in August, 1911, averaged 786 motor vehicles and 4558 horse-drawn vehicles, a total of 5344 vehicles per day with a tonnage much above the average. The pavement is 36 ft. wide. The surface of the pavement has the appearance of a terazzo floor and although the surface wears comparatively smooth, the pavement offers an excellent foothold for horses in all kinds of weather. Where the vehicles have tracked each other over a portion of the original pavement, there is a well defined, rounded rut, showing that there is considerable abrasion wear.

The history of this particular pavement has been discussed somewhat fully because it has helped to determine the use of concrete pavement in Kansas City. It is not an example of a well constructed pavement, nor is it an example of an economical pavement. It rather represents a street which should not be paved with concrete in any form. On account of the extreme conditions to which this particular pavement has been exposed, the behavior of a properly constructed concrete pavement on a light traffic street can better be forecasted.

Prior to the paving of Sixth St., very little concrete paving had been laid on streets, but in 1911, the city laid over 46,000 sq.yd. or 3.3 miles of plain concrete pavement on streets at an average cost of $1.23 per sq.yd. This included a small amount of two-course pavement at a cost of $1.47 per sq.yd. In the year 1912, 237,000 sq.yd. or 14.9 miles of concrete pavement was laid on streets in Kansas City at an average cost of $1.05 per sq.yd., for pavement 6 in. thick. The season of 1913 will probably equal 1912, in the amount of concrete laid.

EXPANSION JOINTS

Practically all of this pavement has been laid under the same specifications, which followed very closely those used in the paving of alleys and of Sixth St., as described above. There was this difference, however; ½-in. transverse expansion joints, filled with asphalt, were provided for at 50-ft. intervals. The objections to a joint of this kind are numerous and obvious; they were tolerated only because it was thought necessary to provide for expansion in the monolithic slab of concrete. The pavements laid in 1911 and early in 1912 were carefully watched and compared with the pavements on streets and alleys where no expansion joints had been provided. These streets and alleys appeared to be freer from longitudinal cracks and secondary transverse cracks than those laid with ½-in. expansion joints. There also appeared to be little, if any, movement at the joints, under extremes of temperature. It seemed logical to suppose the concrete never again occupied as much space as when it was first placed on the street in a wet mass, that the expansion strains could be disregarded as far as their effect on the disruption of the pavement was concerned, that no form of expansion joint satisfactorily performed its functions and that the only serious temperature effects to be considered were those of contraction. The specifications were accordingly changed late in 1912 to provide for a paper transverse joint every 30 ft., so that any contraction which would tend to disrupt the pavement would

FIG. 3. VIEW OF CONCRETE PAVEMENT FROM ELMWOOD AVE. TO LAWN AVE., KANSAS CITY, MO.

(This pavement was laid in the spring of 1911. The expansion joint is made by withdrawing a ⅛-in. steel template. There has been no need of any repairs to date and the pavement is in first-class condition, June, 1913. The pavement was surfaced with thin grout on completion, which shows in the dark patches in the left foreground. Ordinary suburban residence traffic—no unusual condition.)

form cracks in straight lines. No other joints were provided. An examination of such of this pavement as went through the past winter shows that no cracks have so far appeared except over the paper joints and these are not noticeable, and not nearly as unsightly as the old form of expansion joints.

Specifications

The present specifications under which all concrete pavement is now being laid on the streets of Kansas City, contain the following self-explanatory paragraphs in addition to the usual ones regarding rolling the subgrade, drainage, cement, sand, etc.

BROKEN STONE—The broken stone shall be clean, hard limestone, with largest stones of such size as will pass a 2-in. ring and with all material that will pass a ½-in. screen removed. The stone must be free from dirt or any deleterious matter and must contain practically no soft, flat or elongated particles.

PROPORTIONS OF CONCRETE—The portland-cement concrete shall be composed of one volume of cement, 2½ of sand and 4½ of clean, broken stone. All measurements are to be of the loose materials.

MIXING—Concrete must be mixed by a machine of a type

Fig. 4. Concrete Pavement on 20th St. from Cypress Ave., Looking East, Kansas City, Mo.

(The grade on the first block of the pavement is 12.3%. This pavement was laid in the fall of 1912 under new city specifications, with no expansion joints, but paper contraction joints, which show only as a faint line across the street and are not noticeable except on close examination. This pavement has been exposed to temperatures ranging from 10° below to 90° above zero with no signs of the least damage. The marks on the pavement are dirt on the street. Examples of paving like this and that shown in Fig. 2 could be multiplied indefinitely in Kansas City.)

that will insure accurate proportions of the ingredients, and be acceptable to the City Engineer.

The materials shall be mixed wet enough to produce a concrete of such consistency that it will flush readily when tamped, but which can be handled without causing a separation of the coarse aggregate from the mortar, and which will not creep toward the curb or sag out of place when deposited and lightly tamped. After the addition of water the mixture shall be handled rapidly to the place of final deposit. Under no circumstances shall concrete be used that has partially hardened.

DEPOSITING CONCRETE—The concrete must be taken from the machine in such manner as will insure against loss of mortar, and deposited to such depth that when tamped and properly finished the pavement shall have a thickness of 6 in., and the upper surface shall be true and uniform.

To assist in bringing the street surface to correct grade and crown, the contractor shall drive stakes at center and quarter points of roadway at intervals not greater than 25 ft. These stakes shall be firmly driven with their tops at the elevation of the finished pavement, or, if preferred, with a well defined mark at this elevation, so that during the laying of the concrete it will be possible to stretch a line from a stake to the one in advance for the purpose of determining any irregularities. When the stakes in front have been reached, the set just passed shall be removed and the holes carefully filled.

The concrete must be deposited in strips transverse to the roadway, and when interruptions occur of such length as to permit the setting of concrete, the pavement must be finished against a board set vertically and at right angles to the street, so that the depositing of concrete may be resumed without disturbing that already in place.

FINISHING—The pavement shall be finished by thorough hand tamping, until the mortar flushes freely to the surface, then lightly tamped and broomed with fiber push broom—the final markings to have a neat and uniform appearance transverse to the roadway.

CLEAVAGE PLANES—At intervals of approximately 30 feet, transverse cleavage planes shall be constructed by placing a board in a vertical position across the roadway and on the rear side of the board a layer of heavy building or roofing paper. This board shall be held in place by stakes until the concrete has been deposited for a distance of at least 6 ft. in advance, when it shall be removed and the place it occupied carefully filled with concrete and finished in same manner as the rest of the pavement. The paper used must be stiff enough to maintain itself without tearing or wrinkling and shall not extend above the surface of the pavement.

Between the curb lines of an intersecting street or alley that is unpaved, the concrete pavement shall be finished against a white-oak plank 2 in. thick and 12 in. deep and of such length as the Engineer may designate; the upper edge of the plank to be neatly adzed off to conform to the finished surface of the pavement. Where the work adjoins any pavement already laid, the Engineer may require the Contractor to remove and relay a sufficient quantity of the old pavement to form a satisfactory junction of the two pavements.

SPRINKLING—During the first four days after placing, the concrete shall be kept moist.

At all times during the construction of the pavement nothing must be allowed upon it that will disturb the concrete while setting, and the street shall not be thrown open to traffic until the Engineer so directs.

Construction Details

Nearly all the pavements laid are 6 in. thick, although occasionally, where there is considerable heavy hauling, and the subgrade is soft, the thickness is specified at 7 or 8 in. No attempt is made to get as good a finish on the surface as would be expected on a sidewalk; the pavement is neither templated, floated nor troweled. The finished surface obtained by brooming and tamping is, however, suitable for street purposes, is easy riding, and has a neat, uniform appearance. Every attempt is made to get a dense compact, well cured concrete, as every precaution ordinarily taken to insure good concrete benefits the paving. The broken stone used is a limestone, which wears faster under the abrading action of traffic than the 1:2½ cement mortar surrounding it and yet does not break out or chip. This allows the pavement to wear evenly. In the writer's opinion, it might be advisable to increase the strength of the mortar if harder stone were used; otherwise the stones might pick out as soon as the mortar support around them has worn down slightly.

Costs

The average cost of $1.05 per sq.yd. for 1912 represents the average contract price and includes profit, a five-year guarantee to maintain and repair the pavement, and final payment in tax bills against the abutting property, which the city does not guarantee as to validity. An itemized statement of the actual cost to a well equipped contractor of laying one square yard of 6-in. concrete pavement at average prices for material in 1912, based on some 40,000 sq.yd. of pavement laid under 12 contracts, follows:

AVERAGE COST PER SQ.YD. OF 6-IN. CONCRETE PAVEMENT

Subgrading and rolling	$0.118
0.22 bbl. cement @ $1.35 per bbl., delivered on the job	0.297
0.082 cu.yd. sand @ $1.25, delivered	0.103
0.147 cu.yd. rock @ $1.50 per cu.yd.	0.221
Labor and fuel, mixing and placing; $1.75, eight hours common; $2 to $2.50 best labor.	0.118
Overhead charges (tax-bill discount, depreciation of tools, superintendence, etc.)	0.072
Total cost per sq.yd.	$0.929

The average contract price on the above contracts was $1.04 per sq.yd., leaving a balance of 11.1c. as profit and to take care of repair during the five-year guarantee. The cost of cement has varied considerably the past year with a marked upward tendency.

Advantages and Disadvantages

To most people, especially the property owners who have to pay for the paving, low first cost is the strongest recommendation for concrete paving. It has a number of other advantages, however. It is never slippery in any kind of weather, and has been laid on grades in Kansas City as high as 18%. It is of low tractive resistance, offers an excellent foothold for horses, and at the same time is smooth enough not to be a dirt catcher. It has a neat appearance, is sanitary and can be repaired at low cost. Since no large plant is required to lay it and the materials used are familiar to all contractors and are easily manipulated, concrete opens the paving game to the keenest competition. This fact should especially recommend it to many small towns which are often overrun with paving promoters, as it frequently allows local contractors, who are usually interested in obtaining satisfactory results, to obtain the work.

Concrete paving, on the other hand, is objectionable on account of its white and glaring appearance, its tendency to develop unsightly cracks, and the fact that, under heavy traffic, holes develop where the concrete mixture is not quite uniform. It is also difficult to make satisfactory joints with the old pavement in repairing holes, and under heavy steel-tired traffic, there is considerable abrasion loss even if no holes develop.

In other words, there are limitations to concrete paving as there are to other forms of paving. Its indiscriminate use through failure to recognize this will prove uneconomical and dissatisfying. Concrete should not be placed in competition with the various forms of asphalt, or brick. Streets on which such pavement ought to be laid, cannot be successfully paved with concrete. There are, however, streets in every city where suburban property is beginning to build up, where street connections are necessary through long stretches of vacant property, and where the property required to pay for the improvement is of a poor class, but where paving is desirable from a sanitary standpoint. In such locations concrete paving is satisfactory and economical. The quiet residence streets of small towns also represent a proper location for concrete paving. On account of its low first cost and low cost of upkeep under light traffic, streets are often paved with plain concrete, which otherwise would remain unpaved. It can often be laid as a temporary pavement and used later on as the foundation for a more permanent surfacing, thus distributing the cost over a period of years at a time when the property is building up.

This, in a way, explains the reason for the success of plain-concrete pavement in Kansas City. The soil is a stiff clay which will mire any two-horse team in wet weather and the grades as a rule are heavy. The city limits were extended two years ago, nearly doubling the area of the city and the new territory demanded improved streets connecting with the older portion of the city. The cost of all improvements are taxed directly against the property benefited so that the development of a cheap and satisfactory pavement has proved a boon to the salaried suburbanite, who is buying his small home on the installment plan. It has been the aim of the engineering department to draw the specifications so as to get a first-class concrete with the least expense for labor or material. It is neither necessary nor desirable to have a float or troweled finish to a pavement, the slight ridges left by the broom soon wear off under traffic. The strength of the mortar should also be proportioned to the wearing qualities of the rock used, so that they will wear together. All concrete pavement in Kansas City is laid low enough so that it may, at some future time, be used as a foundation for asphalt or other surfacing not exceeding 4 in. in depth. This makes a slightly higher curb face than ordinary, but is in no way objectionable. The cost may be further lessened by constructing the concrete curb in connection, and as a monolith, with the pavement.

In conclusion, the writer wishes to emphasize the fact that under the present condition of mixed traffic, concrete paving in any form should not be indiscriminately applied to city streets. It is the duty of the engineer to recognize that concrete has limitations like all other paving materials and not expect to use it exclusively. There is a very wide field for its use on highways and on numerous streets in towns and cities. Its proper use under proper specifications and inspection will undoubtedly solve many paving problems and prove a profitable investment for the tax payers. Local conditions in Kansas City have particularly favored the construction of this class of pavement and by using good judgment in location, practically all of the concrete paving in Kansas City is giving satisfaction. No repairs have been necessary on any of the pavement laid in the past two years.

Coöperation in Irrigation Work between State and Federal governments has been inaugurated by Secretary Franklin K. Lane, of the Interior Department. At the suggestion of the Conservation Commission of the State of Oregon, the Governor and State Engineer of Oregon entered into an agreement with the Reclamation Service some months ago under which the State and the Reclamation Service have appropriated $50,000 to make joint investigations and surveys for irrigation development in the Deschutes Valley in Oregon. In conformity with the favorable report of the engineers engaged on these surveys, the State of Oregon has appropriated $450,000 to be used in construction work and Secretary Lane has agreed to ask the President to set aside from the Reclamation fund a similar sum to be used for the completion of the work under joint control of the State and Federal engineers.

Employees Suffering from Communicable Diseases are being debarred from the dining car and restaurant department of the Pennsylvania Railroad under a rule recently established. Quarterly physical examination will be made of every employee who has anything to do with the preparation or serving of food, dishwashing, etc., and only those who pass the examination on a 100% basis will be permitted to remain in the service. This disbarment will extend even to those working in places where linens and table-ware are kept. Particular attention will be given to tuberculosis and diseases of the eye or skin. Supplementary to the precautions outlined, there will be provided at "lay-over points" for dining-car employees, special lodgings with clean linen and other sanitary precautions. These lodgings will be inspected by officials of the dining car and restaurant service and by the medical examiners of the company.

A Double-Deck Bascule Bridge

A double-deck bascule bridge over the Chicago River is the principal feature of a project for improving the connection between the business district and the north-side residence district of the city of Chicago, and providing a connecting link in the boulevard system. At present, Michigan Ave. is a wide and handsome boulevard as far as Randolph St., beyond which it is a narrow street to the river, where it is blocked by steamship docks and sheds. The north side of the river is similarly occupied, but the boulevard system on Pine St. (nearly in line with Michigan Ave.) extends to within a few blocks of the river. The only bridge connection is an old and narrow swing bridge at Rush St. (a block west), and this has to carry the extremely heavy and congested traffic. This traffic includes heavy teaming traffic to the docks and warehouses and an almost incessant stream of automobiles between the city and the residence district.

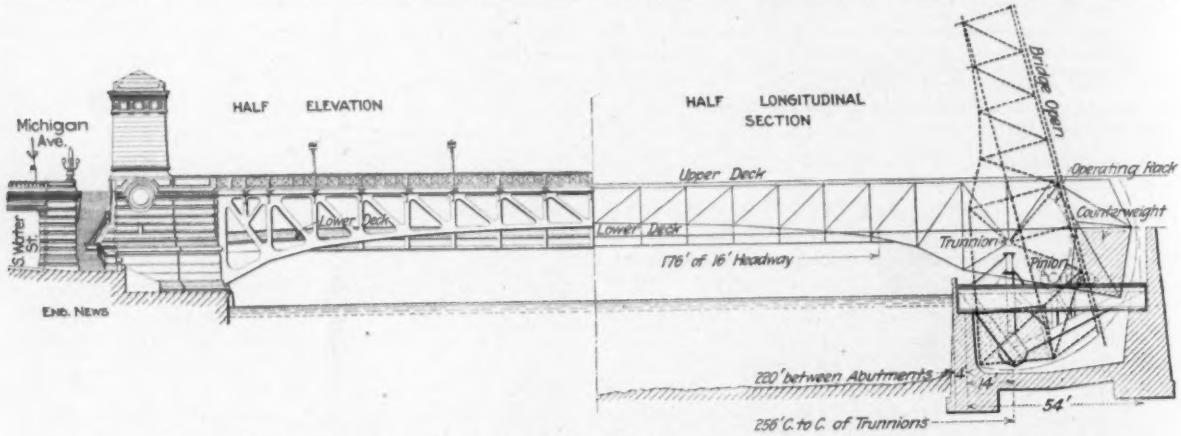


FIG. 1. DOUBLE-DECK BASCULE BRIDGE TO BE BUILT OVER THE CHICAGO RIVER AT MICHIGAN AVE.

The present plan of improvement is to widen Michigan Ave. north to the river and Pine St. south to the river, and to span the river by a bridge of ample capacity for the traffic. To provide this capacity it is proposed to build a double-deck structure. The lower deck (60 ft. wide) will be at the level of the river-front streets and will accommodate the local and teaming traffic. The upper deck (90 ft. wide) will be for the fast vehicles and pleasure driving, and will have inclined viaduct approaches of steel and concrete construction. This improvement is estimated to cost about $2,300,000, exclusive of land to be acquired. For information as to the work and the bridge we are indebted to C. D. Hill, Chief Engineer of the Board of Local Improvements, under whose direction the detail plans of the bridge have been prepared, as well as the general plans of the entire improvement.

The bascule bridge will be of the fixed-trunnion type, as shown in Fig. 1, the trunnions being carried by a steel framing on concrete piers, between which will be the counterweight pits or tail pits. It will be of the double-leaf type, and each leaf will consist of two parallel adjacent portions which will be operated normally as one structure, but which can be operated separately and independently if necessary, as in the event of any accident or failure affecting only one portion. The distance between the trunnions will be 256 ft., and the clear span between abutments will be 220 ft. When the bridge is closed it must give a clear headway of 16½ ft. above the water for a distance of 176 ft., and when open it must give a clear width of opening of 220 ft. to a height of 120 ft. The trunnions will be 15 ft. above datum (or normal water level).

Each leaf of the bridge will have four trusses, forming two separate but adjacent and connected structures, as noted above. The two trusses of each part will be 27 ft. c. to c., and the two adjacent inner trusses will be 6 ft. c. to c., giving a total width of 60 ft. between the outer trusses. Each side of the lower deck will carry between the trusses an 18-ft. roadway and a 5-ft. sidewalk. In each roadway will be a single street-car track, having its center line 7 ft. 3 in. from the center of the inner truss. Each side of the upper deck will have a roadway 27 ft. wide between wheel guards and a 15-ft. sidewalk carried outside of the outer truss by cantilever floor beams. Between the two roadways will be a refuge

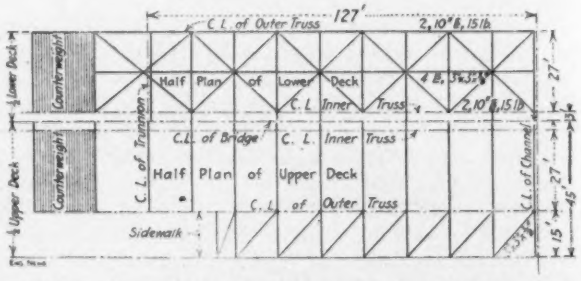


FIG. 2. PLAN SHOWING ARRANGEMENT OF TRUSSES, FLOOR-BEAMS AND LATERAL BRACING

or walk 5½ ft. wide. The clear headway above the lower deck will be 13½ ft. Fig. 2 shows the arrangement of the trusses, and the floor beams and lateral bracing of the two decks.

The roadways of the lower deck will be paved with 4-in. creosoted wood blocks fastened to a layer of 2-in. plank on 4x6-in. sub-planking. The latter planking is to be laid upon the roadway stringers, which will be I-beams framed between the floor beams, except that the stringers under the car tracks will be plate girders. The roadways of the upper deck will be paved with asphalt on a buckle-plate floor, the asphalt being reinforced by a continuous sheet of wire netting fastened to

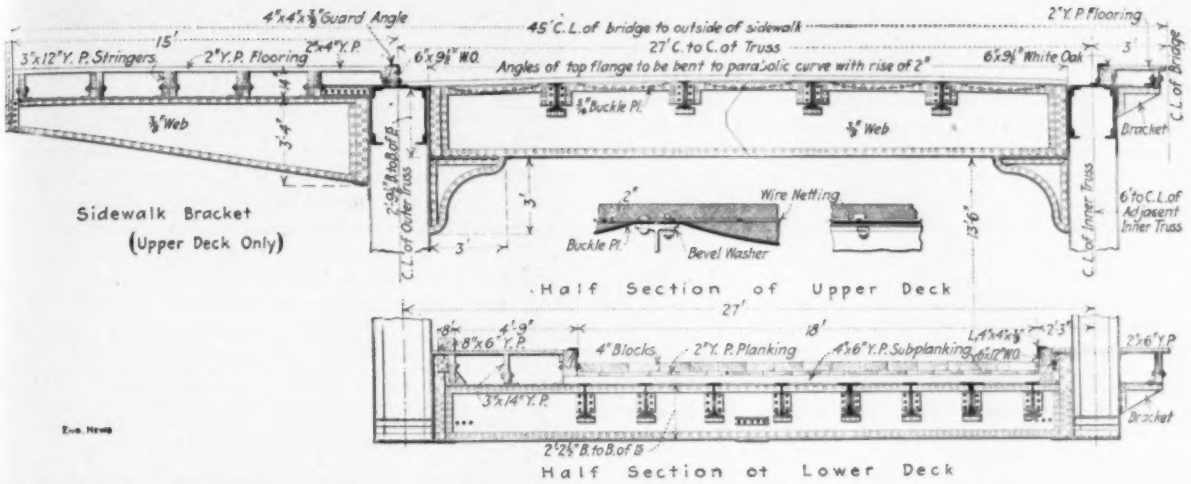


FIG. 3. FLOOR BEAMS AND PAVING FOR THE MICHIGAN AVE. DOUBLE-DECK BASCULE BRIDGE, CHICAGO

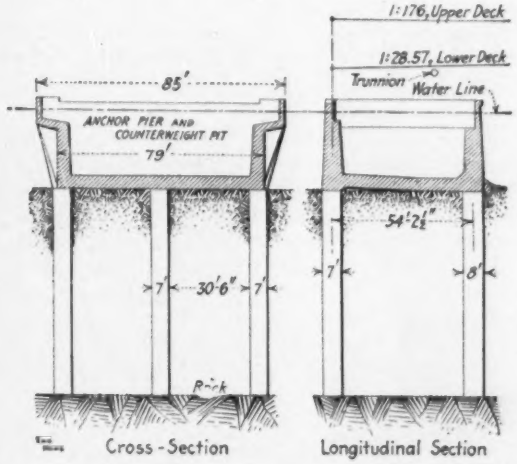


FIG. 4. BOX PIER ON CYLINDER PIERS FOR DOUBLE-DECK BASCULE BRIDGE

the stringer flanges by hook bolts. All sidewalks, and the center walks, will have 2x6-in. pine planking on pine stringers. All timber used in the bridge will be creosoted. Fig. 3 shows a cross-section of each deck, with its paving.

The live load for the upper deck is taken as follows: (1) two 20-ton vehicles close together on each roadway, each with four wheels, carrying 5 tons load, spaced 5 ft. and 10 ft.; (2) allowing 10x20 ft. for each vehicle, the remaining area (including sidewalks) will have a uniformly distributed load of 100 lb. per sq.ft. The live load for the lower deck is taken as follows: (1) on each roadway a continuous line of 50-ton 50-ft. street cars and a 20-ton moving vehicle (as above); (2) a distributed load of 100 lb. per sq.ft. on all the unoccupied area of the roadway and sidewalks. To allow for dynamic effect of live loads, the maximum computed live-load stress is to be increased by an amount determined by the following impact formula, in which I is the increment to be added, S is the computed maximum live-load stress, L is the length (feet) of load on bridge producing maximum stress, and N is 10% of the total width of roadway and sidewalks loaded to produce maximum stress.

$$I = S\frac{100}{NL + 300}$$

In addition to the above loads, a moving lateral load is assumed of 300 lb. per lin.ft. of each chord or deck. When the bridge is moving, or is open to any extent, the loads causing stress in structural parts of the moving or supporting structure shall consist of the dead weight, with 20% added for effects of vibration and a wind force of 20 lb. per sq.ft. over the entire exposed area.

On each side of the river, behind the anchor piers, will be a machinery room with four 100-hp. electric motors so connected that any two can be used to operate the four-truss single-leaf. Gear trains will transmit the power from the motor shaft to main pinions engaging with segmental racks on the two outer trusses. In addition there will be at each side of the river, a 7½-hp. motor to operate the heel locks supporting the tail ends of the trusses, and on the south leaf of the bridge there will be two 5-hp. motors to operate the center locks. For each leaf there will be hand and compressed-air brakes.

The substructure on each side will be a box-shaped pier, forming the abutment and tail pit, with the front and back walls each supported by three 8-ft. concrete-cylinder piers extending down to solid rock. This is shown in Fig. 4. At each end of the bridge will be two houses for the use of the bridge tenders, and these will be of ornamental character, harmonizing with the architectural treatment of the approaches. In view of the character and importance of this structure it is intended to give particular attention to the attractive design of the bridge itself and its approaches and surroundings, for which purpose there will be a broad open space or plaza on the upper level over each of the abutment piers.

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Work of the Seagoing Suction Dredges on the Panama Canal—During the calendar year of 1912, the "Caribbean" removed 2,754,755 cu.yd. from the Atlantic entrance channel at an average cost of $0.03807 a cu.yd. The average unit cost of repairs made to the dredge during that year was $0.0364 to the cu.yd. On the Pacific side, the "Culebra" excavated 2,436,505 cu.yd. in 1912, at an average unit cost of $0.04897 a cu.yd. and the average unit cost of repairs during the same period was $0.02855 a cu.yd. ["Canal Record," Apr. 23, 1913.]

A Letter by John Louden M'Adam, the Roadbuilder

Some of our readers who have arrived at an age when an old book is more attractive to them than a new one and who have learned the pleasure there is in browsing among the literature of a past generation are doubtless familiar with the *Mechanics Magazine*, which was one of the earliest journals in the United States devoted to science and engineering.

Mr. Samuel Whinery has recently sent us a copy of this old journal published over 80 years ago, in April, 1833, containing a letter written by John Louden M'Adam to Charles H. Hammond of Bennington, Vt.

In a letter published in the *American Railroad Journal* (another of the early pioneers in engineering literature in America) Mr. Hammond had urged that the M'Adam system of road making should be adopted in the United States. The letter came to M'Adam's notice and we reprint the following interesting extracts from the letter which he sent to Mr. Hammond:

I am glad to see that the science of road-making has attracted notice in America, and I am flattered by your approbation of the system which I have ventured to recommend to my country.

It is in vain to expect economy to be obtained in road-making unless the whole work be done by the laborers by piecework. Whenever day labor is the system, extravagant expenditures and boundless profusion will be the consequence.

The sub-surveyor, whose duty it is to be constantly present where the work is proceeding, ought to be able to fix the price of work by weight or measurement, and to make fair and equitable bargains with the workmen, by which they may be enabled to earn the reasonable wages of the country, using a proper degree of industry.

Our plan of distributing piecework among the workmen is to employ them in gangs, never exceeding five men; one of whom, selected by themselves, is called the gangman, and with him the bargain is made by the sub-surveyor for pieces of work sufficient to employ the gang about a week, as no great loss or damage can happen in that time and on that quantity. If the gang do the work well, and earn fair wages by industry, they get another bargain; if idle, or disposed to slight the work, they are not again employed, by which means a road is in a short time supplied with good and expert workmen.

When the improvement of roads commenced in England in 1815, the cost of repairing the Bristol roads (178 miles) was about £19,000 annually ($525 per mile), the roads then in such a condition as to be almost all under notice of indictment—at resent the annual cost of repairs is about £13,000 ($360 per mile), including salaries for management.

I took the charge as general surveyor of the British roads in 1815, and was obliged to instruct all the sub-surveyors (nine in number); they again instructed others, by which process we obtained, after a few years, some skillful surveyors.

The system followed by my family and myself is to take charge, as general surveyors, of a number of districts of roads, or, as called in England, trusts; upon these we keep one or more surveyors, according to the number of miles and the work in each trust. We employ at present, under my sons, grandsons and myself, about a hundred sub-surveyors, and have in charge a considerable number of roads both in England and Scotland.

The importance of skillful and respectable superintendence in the officers of roads is ill understood in this country—deep-rooted abuses, old prejudices and some great defects in our system of road law as to contract, have all contributed to prevent the whole benefit we might derive from good roads at a moderate cost, notwithstanding the experience of eighteen years.

Experience during eighteen years' practice has instructed us in many particulars that appear trivial, but which we find to be very important in making a road solid, impervious to water, smooth in the surface so as to be easily traveled upon, and consequently kept in repair at a reasonable expense. Some theoretic opinions, at first adopted, have been corrected—others given up as erroneous; the science of road-making is still capable of improvement for the benefit of mankind.

Having resided fourteen years in America, and having seen the effect of severe frost and sudden thaws on roads, I am quite safe in assuring you that more skill and care in the construction of roads are required in America than in England.

I have the honor to be, sir, your most obedient servant,
JNO. LOUDON M'ADAM.

It is of no small interest that in the same issue of the *Mechanics Magazine* in which this letter of M'Adam's appears, there are two articles discussing steam vehicles for use on common roads, a line of invention which was then in a most active state of development in England. The letter learnedly discusses the relative merits of the steam carriages of various inventors and remarks:

Theoretically I think Mr. Walter Hancock's boiler the best, having the greatest heating surface with the least weight; but I imagine thin metal heated by blast will not wear to pay its charges. In fine, I think at present a locomotive engine cannot be made substantially for regular economical work under half a ton weight per horsepower. He who builds an engine to propel a common stage wagon will in my opinion soonest find his reward, and even here two steam horses will have to be maintained to do the work of one living horse by reason of the weight of the engine, fuel, water, etc.

Another brief item, headed "Ogle's Steam Carriage," reads as follows:

On Saturday morning last Mr. N. Ogle, accompanied by several gentlemen, proceeded from the Bazaar in Portman St. to Stamford Hill. The distance of seven miles was accomplished notwithstanding the crowded state of the road in 31 min.

All this was in 1833, eight years after the triumph of George Stevenson's "Rocket" in the Stockton & Darlington trials had marked the real beginning of the railway era. As our readers familiar with the history of mechanics know, the rapid development and great economic success of the railway from that time forward diverted the attention of engineers and mechanics from the possibilities of transportation over common roads. It was not until a full half century later that interest revived in the construction of good highways and the design of vehicles propelled by mechanical power to run upon them.

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Floating Cranes for the Permanent Equipment of the Panama Canal*

Contracts have been let for two floating cranes of the revolving type, of 250 tons capacity each, to form part of the permanent equipment to handle lock parts and cargoes in the maintenance and operation of the Panama Canal. There were four bidders for the cranes, one American, one English, one Dutch, and one German. The proposal of the German firm, the Deutsche Maschinenfabrik A. G. of Duisburg, was so much lower in price than any other, and the experience, facilities, and reputation of this firm were so excellent, that it was unquestionably the best of those received. The contract time of delivery for the two cranes was 580 days.

The pontoons, after being fitted with a part of the machinery located below deck, will be towed to the Isthmus, and at the same time the superstructure will be shipped to the Isthmus in a knocked-down condition, final erection of the superstructure and placement of machinery parts being made after arrival on the Isthmus.

The cranes are so high, and the weights of the superstructure are so great, that the erection of the jib or arm which carries the loads will probably be effected in one of the canal lock chambers, permiting the jib to be assembled on the lock wall and fitted to the remainder of the superstructure below.

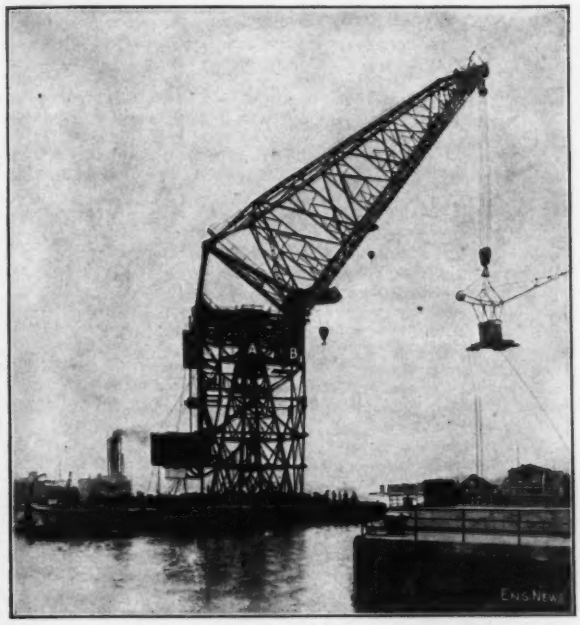
After final erection and adjustment, each crane will be subjected to a comprehensive series of tests, during which it will be required to demonstrate its ability to handle all the specified loads at the specified reaches and to perform all of

*Abstract from the "Canal Record" May 28, 1913.

the required motions. The test loads will be 20% in excess of the rated loads for the "main hoist," and 33⅓% in excess of the rated capacity of the auxiliary hoist. This means that the maximum weight which must be handled without overstrain is 300 gross tons or 672,000 lb.

The type of floating crane decided upon for the canal is believed to be that which affords the greatest flexibility of movement combined with safety. Some types of floating cranes are so rigged that to move the load in any direction except in straight vertical and horizontal lines, it is necessary to maneuver the pontoon, an operation which requires considerable handling of lines, tug service, etc., and a large force of men, and involves considerable delay. Furthermore, a prime necessity for floating cranes for the Panama canal is their ability to operate in the restricted water areas of the canal locks, as it may be necessary for them to assist in the removal of an injured lock gate, and for this purpose the revolving type is unquestionably superior to any other.

In some types of cranes their stability when handling heavy loads is dependent on movable counterweights or water ballast, the operator being required not only to handle the load, but also to adjust properly the counterweight or water ballast. This is not only a great inconvenience, but it may also be a source of positive danger, for if the line holding the load should break, it is not impossible that the counterweight would be in such position as to capsize the crane.



FLOATING CRANE OF 250 TONS CAPACITY FOR PANAMA CANAL, LIFTING A 25-TON CRANE

(A, combination collar and roller bearing for revolving jib. B, operating house, 60 ft. above water.)

In the cranes for the Panama canal, there are no movable counterweights or water ballast; on the contrary, such counterweights as are provided are fixed in weight and position, and the necessary stability when handling maximum loads is had solely by the dimensions of the pontoon considered in connection with the deadweights and loads to be carried.

The cranes for which contract has been awarded will each consist essentially of a steel pontoon 150 ft. long, 88 ft. wide, and of a depth of 15 ft. 9 in. at the sides, and 16 ft. 8 in. at the center. The pontoons will be strongly framed with beams and girders and will be subdivided into watertight compartments of such dimensions that any two exterior compartments can be flooded and the crane remain stable with full load at full reach in any position, and with wind pressure, of 10 lb. per sq.ft. from the most unfavorable direction.

The pontoons will contain a power generating installation, consisting of a Scotch marine steam boiler, supplying steam to marine type engines driving the main and auxiliary electrical and generating units. These units will furnish direct current at 220 volts to motors located on the superstructure, which latter will drive the wire ropes actuating the blocks to which the loads will be attached.

The cranes will not be self-propelling, but the pontoons are fitted with towing bitts, etc., so that they can be handled by tugs. Each pontoon is fitted with four steam capstans, one near each corner, whereby the cranes can be maneuvered to any desired position.

To safeguard the cranes in possible heavy weather or other circumstances, each is provided with two 3,000 lb. anchors and the necessary chain cable, two steam anchor winches being provided for each crane to handle the anchors.

An area, 20x60 ft. on the deck of each pontoon is made especially strong—capable of carrying a superimposed load of 2000 lb. per sq.ft. This area is intended for the reception of loads up to a total of 300 gross tons. The cranes can therefore carry very heavy and bulky loads on their decks when it is necessary to transport them anywhere on the canal, thus rendering unnecessary the use of barges, etc., for this purpose.

The pontoon supports the fixed and revolving superstructure at a point 39 ft. from one end and midway of the width of the pontoon. In general the superstructure consists of three parts: (1) the fixed tower, or mast, consisting of a four-sided truncated pyramid firmly secured to the pontoon framing; (2) the revolving "bell" which is a four-sided, steel framed structure which is supported by a combination collar and roller bearing on top of the mast; (3) the arm or jib which is supported on the bell by two hinge pins, and is capable of motion about these pins, the motion being imparted to it by means of two links connecting it to two crossheads situated at the rear of the bell and actuated by two vertical screw spindles driven from the machinery house.

The bell supports the machinery house which is situated at the rear of the bell, and a short distance above its bottom. This machinery house contains fixed counterweights, as well as the motors, gears, drums, etc., for operating the main and auxiliary hoists. The bell also supports the driver's cab at a point just below the hinge pins of the jib, from which the operator commands an unobstructed view of the entire field of work.

The bell terminates at its bottom on a circular steel girder carrying rollers which press against a roller path secured to the mast. The motors for revolving the bell and jib around the mast are fixed at the bottom of the mast and drive gears engaging a circular rack on the annular girder forming the base of the bell. All motions are in the complete control of one man whose station is in the driver's cab. In addition to the driver there will be required a machinist in the machinery house on the bell, another machinist in the generating plant in the pontoon, and a fireman for the boiler; thus, with the exception of the deck force for handling lines, etc., but four men are necessary for the operation of each crane.

From the foregoing description of the superstructure, it will be seen that the entire revolving weight rests on the top of the mast and that the jib is prevented from overturning by the resistance of the collar bearing at the top of the mast and the rollers at the bottom of the bell. The clearances are such that no part of the revolving superstructure, except the jib, overhangs the pontoon in any position, thus rendering it possible to operate the crane in restricted spaces. The heights of the superstructure are such that unencumbered passage around it is provided in all positions.

The jib is provided with two hoists designated the "main hoist" and "auxiliary hoist," respectively. The main hoist is fixed at the point of the jib and will consist of two equal blocks, each of a rated capacity of 125 gross tons. These two blocks can be linked together by means of an equalizer bar, whereby they may be made to form substantially one ho'st of 250 tons capacity. Each block of the main hoist will be suspended in ten parts of 2-in. wire rope.

The auxiliary hoist will have a rated capacity of 15 gross tons, and will consist of a two-part block swung from a traveling trolley running on a runway secured to the lower side of the jib in such manner that the auxiliary hoist can be operated at any point of this runway at any position of the jib.

The main hoist can handle its rated loads at any point in a full circumference of 360° with the mast as a center. It can revolve completely under maximum loads and can in addition be luffed in or out by means of the above-mentioned links and screw spindles. The main hoist will have the following capacities at the reaches stated for each; by reach is meant the horizontal distance from face of pontoon fender to center of block:

	100 tons	150 tons	250 tons
Loaded reach over end	80.1 ft.	59.0 ft.	21.0 ft.
Loaded reach over side	81.6 ft.	62.4 ft.	22.3 ft.

From any of these reaches the main load can be luffed

in sufficiently far to enable the crane to deposit such load on its own deck.

The time of hoisting main loads is as follows:

Tons	Per minute
250	3 ft. 6 in.
125	7 ft.
62.5	14 ft.

The unloaded blocks are raised or lowered at not less than 20 ft. per minute. The crane can make one complete revolution in from 5 to 8 min., depending on the load and wind, the lower figure being for the most favorable condition without wind. The jib loaded with 100 tons can be luffed in from its maximum to minimum reach in not more than 17 min., and luffed out in not more than 13 min. Without load the jib can be fully luffed in from maximum to minimum reach in not more than 10 min. and luffed out in not more than 8 min.

The speed of hoisting the fully loaded auxiliary block will be not less than 40 ft. per min., and the unloaded auxiliary block can be raised or lowered at no less than 80 ft. per min. The speed of trolleying the auxiliary hoist along its runway will be from 40 to 80 ft. per min., depending upon the degree of inclination of the jib.

Each crane will be safely stable in a wind exerting a pressure of 40 lb. per sq.ft., even with full 300-ton deck load on the pontoon, although of course the operation of the cranes would not be attempted in such a gale.

The pontoon will have a freeboard of not less than 3½ ft., when handling maximum capacity loads in any position without deck load; if the deck load be present this free load will be reduced to not less than 2 ft. The maximum longitudinal inclination of the pontoon will not exceed 2½°, and the maximum transverse inclination will not be greater than 5°.

Each crane will be provided with ladders, stairs, gangways, etc., for convenient communication, inspection, and repair, will be fully equipped with all necessary signals and means of communication, and will be electric lighted throughout.

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The Engineer as an Economist

Apropos of the editorial in our issue of June 5, contradicting Senator La Follette's claim that professional economists and not engineers, should be placed in charge of the work of railway valuation, a correspondent calls our attention to the Presidential address of Dr. Dugald C. Jackson, delivered two years ago before the American Institute of Electrical Engineers. We quote the following extracts:

Members of the American Institute of Electrical Engineers are pleased to refer to electrical engineering as a profession, and to the Institute itself as a professional society. The word profession "implies professed attainments in special knowledge, as distinguished from mere skill; a practical dealing with affairs, as distinguished from mere study or investigation; and an application of such knowledge to uses for others, as a vocation, as distinguished from its pursuit for one's own purposes."

This sets the professional man in a position which demands from him an attitude of service and of leadership. He must have a masterly knowledge, in addition to skill in a vocation. He must deal practically in the affairs or needs of men. His duties must be performed with a touch of disinterested spirit in addition to the vocational spirit of earning his livelihood. Such men have a duty to the public; and in the performance of that duty they must exert their influence on that thought and practice of the day which affects the welfare and progress of the nation.

It may be retorted that questions relating to the welfare and progress of the nation are matters of economics and sociology, and not of engineering. The affirmation contained in this retort I will admit, but the negation I deny.

The theory of modern economics is built up under the influences produced by the introduction of steam power, with its potent agencies comprised in the steam railroad, ocean navigation, and the use of steam power in industrial operations. These agencies are the creatures of engineers. Watt, Stephenson, Fulton, Ericsson, Boulton, Arkwright, Nasmyth, Bessemer, Siemens, Corliss, Holley and the other fathers of our modern industrial economic conditions were engineers; and it would be folly to deny to the parents an interest in their offspring, and equally folly to assert that the further development of economic theory are not largely dependent on those industrial changes which are continually produced by the inventive activities of the great body of engineers.

When I speak of industrial operations or industrial conditions, it must be understood that I include among industrial affairs the great means for transportation and intercommunication which are comprised in railways, telegraphs and telephones, in addition to the manufacture and distribution of products which involve the application of mechanical power as distinguished from animal power, and the manufacture, accompanied by distribution by pipe or wire, of the media for providing illumination and power. The engineers have precipitated these affairs on the world by their inventions; these affairs are in a large measure the support of the engineering profession; and it is the duty of engineers to do their share in molding their various economic creatures so that the creatures may reach the greatest practicable usefulness to society.

In fact, it would show a cowardly weakness to suggest that this duty should be avoided by men who are essentially responsible, as the engineers are, for the existing conditions. Theologians and physicians can practice their professions aloof from the ordinary affairs of the world, but the engineers associated with industrial events cannot. Moreover, such an avoidance of their duty by the engineers, even if avoidance of responsibility were possible, would be particularly unfortunate in view of the fact that the professed economists and sociologists apparently do not yet hold themselves subject to all the requirements of professional men, but still interpret their duties as being more confined to the field of study and investigation than to applying their knowledge to practical affairs.

In the juncture now before us we must utilize the best theories of the corporation relations and the rights of persons and property, and cautiously extend our practices accordingly. No body of men are better equipped for this sound and scientific procedure than a body of professional engineers; and few others are so fully and adequately trained for such procedure as engineers, for the reason that this procedure is in accordance with the everyday steps of their business life. Moreover, the engineers of experience are well adapted to grapple with the mighty problems of a new age, for the reason that an efficient engineer must associate audacity and sobriety in his spirit.

If my premises are tenable, and I believe them to be incontestible, the engineers have a special duty, as professional men who are trained and experienced in straight thinking, to use their influence for the establishment and support of right and reason in the dealings between the public and the public-service corporations.

The public-service corporations compose a comparatively new and mighty force in the social organism, and the organism must be adapted to efficiently utilize this force, but the force must be prevented from dominating or warping the organism. There is no danger of the public-service corporations becoming despots as some people seem to fear, provided they are put under proper restraints, but society cannot afford to make restraints which of themselves are unnecessary or unfair. These corporations serve a beneficial end in our life, and their rights are as well founded and should be as well secured and held sacred as the rights of any citizens.

It is necessary for all men trained in straight thinking to cry out for fair dealing, one with the other, as between the public-service corporations and the public which they are established to serve. No engineer does his duty who does not stand with fidelity for equally square treatment for as by these corporations.

The public, misled or annoyed by the reluctance of some honest but overcautious managements to make frank public statements of financial results and present convincing statistics of operation, enraged by the acts of a few adventurers who from time to time have secured a speculative hold in the public service field, and enticed by the arguments of individuals with ulterior motives, are likely to follow the radical leadership of demagogues or of honest but false empirics.

This is a danger which seriously exists in states where no public supervision of the service companies is provided, and also in a lesser degree in states where such supervision has been established. The danger must be rolled back by the exertions of fair-minded and right-thinking men. A serious menace to the welfare of the nation would be caused if unfair dealing toward the public-service companies were established as a policy. A scrupulously frank and honest dealing with the public by the companies should be insisted on, but the public must be taught the importance of dealing on its part with an equally scrupulous fairness and a well balanced generosity.

The American Society of Mechanical Engineers in Germany

(EDITORIAL CORRESPONDENCE)

On invitation of the Verein Deutscher Ingenieure, the American Society of Mechanical Engineers met with the Verein in joint meeting at Leipzig, Germany, June 23 to 25, 1913.

We left New York June 10, 1913, on the Hamburg-American steamer "Victoria Luise." This is the old "Deutschland," which held the transatlantic speed record prior to the "Lusitania" and "Mauretania." She obtained her high speed, however, at the cost of much vibration, so her engines were exchanged for lower power, reducing the sea speed one-third and she was transformed to a cruising yacht for ocean tourists, carrying only first-class passengers. She has Frahm anti-roiling tanks,* and whether because of these tanks or of the phenomenally fine weather which prevailed during the whole voyage the ship was remarkably steady, most passengers boasting of not having lost a meal. Games, contests and entertainments both by day and evening furnished amusement during the voyage, especially to the younger members of the party. The success of this part of the trip was largely due to Prof. Arthur M. Greene of Rensselaer Polytechnic Institute who was chairman of the Committee on Entertainments.

Very careful preparations had been made by the German Verein for their American guests. A guide-book to the various cities to be visited on the tour, specially prepared for the occasion and sent to New York in advance of the departure to be distributed to the tourists, at the outset of the voyage, was the first evidence of this; various guide-books to individual cities and programs of entertainment were supplied later. More personal evidence was furnished by four representatives of the Verein who boarded the steamer at Plymouth, England, its first stop: C. Matschoss, representing the headquarters of the Verein; R. Kroebel, consulting engineer; Prof. G. Frasch, of the Hamburg Technische Staatslehranstalten; and J. Molsen, President of the Hafen Dampfschiffahrt Co.; the last three representing the Hamburg local section of the Verein. Further, arriving at Cuxhaven (at the mouth of the Elbe) at 6 p.m., July 18, and at Hamburg by rail at 10 p.m., the party found that complete hotel and baggage arrangements had been made for them by their hosts, being part of the systematic arrangements for the entire 20-day tour through Germany.

Unfortunately the Society lacked some of its leaders. The President, Dean W. F. M. Goss, of the University of Illinois, was unable to accompany the party and was represented during the trip by James Hartness, Vice-President. Of the Society's Committee which has been for a year past making arrangements for the trip, only Col. E. D. Meier was finally able to accompany the party, and he was made its leader.

WELCOME AT HAMBURG

The State of Hamburg welcomed the visiting party to Germany and entertained it during its two-day stay, Friday and Saturday, June 19 and 20. On Friday the doings included luncheon at the Landungsbrücken restaurant and an illustrated address by Hafenbaudirector I. F. Bubendey, Director of the Hamburg harbor works; a steamer trip around the harbor; a reception by the Bürgermeister in the City Hall, and a grand banquet in the Ratsweinkeller, tendered by the city. Senator Sthamer presided at the banquet, and John R. Freeman, Col. E. D. Meier, Worcester R. Warner and Hermann Blohm, of the shipbuilding firm of Blohm & Voss, were among the speakers. On Saturday the party visited the great shipyard of Blohm & Voss (where the "Vaterland," 5000 tons larger than the "Imperator," is being built). Short visits were made also to the double-tube street-tunnel under the Elbe,* the Barmbeck power house† of the Hamburg Elevated Railway Co., and Hagenbeck's "Tierpark."

The manner in which the Hamburg Bezirks-Verein entertained the party during these two days was most cordial and lavish to a fault. Hamburg, in giving the Society its welcome to Germany, made the occasion a special festival, and gave the visitors a characteristic sample of the enthusiastic greetings and entertainment it was to receive later at Leipzig and beyond. Even the fact that the Kaiser came to Hamburg during the visit did not diminish the interest and attention displayed by the local engineers, and at the last a large delegation gave the party farewell greetings at the railway station.

The trip to Leipzig was made on Sunday, June 22, leaving Hamburg at 9:45 a.m. Beginning with this trip the party traveled throughout its visit in a special train of corridor compartment cars, the same train being kept for the use of the party during the whole trip. The provision of this train, its special schedules and other favorable arrangements for the visitors' comfort on the journey were due to the coöperation of the various State Railways.

Nearing Leipzig, two Zeppelin dirigible balloons were seen by the party, performing evolutions at the inauguration of new balloon-sheds, the King of Saxony making a flight in one of the dirigibles as part of the ceremony.

THE LEIPZIG MEETING

Introducing the Leipzig meeting with an informal supper and show on Sunday evening at the Krystallpalast hall, the Verein Deutscher Ingenieure at once plunged the visitors into a whirlpool of cordial entertainment. No less than 1500 persons took part in the supper in the hall, and immediately thereafter a typically "gemüthvolle" welcome was given the guests [amid a plentiful supply of Münchener]. In the middle of a musical program, Mr. Siegfried Moltke, librarian of the Handelskammer, delivered an extended poetical "Prolog," which included greetings to the visitors and a review of the great moments in Leipzig's history. Later, the entire assemblage sang a "Festlied" written for the occasion, expressing the greatness of the engineer and celebrating the meeting. Later still, after a "variété" performance, and but three hours after the supper, a "repast" was had.

This introductory festivity gave added force to the for-

*Lateral tanks connected below by a large water conduit and above by an equalizing air passage fitted with throttling valves. When the ship rolls, the tanks introduce a damped out-of-phase component which reduces the roll materially.

*Completed about a year ago. One roadway and two footwalks in each tube. Shield-driven, with sectional steel shell and concrete inner lining. No artificial ventilation. Designed by the Hamburg harbor department and built by Philip Holtzmann & Co.

†An A. E. G. steam-turbine station with chain-grate water-tube boilers. The line has underrunning third-rail station blocking; several sections in subway.

mality of the joint meeting of the Verein and Society, which opened Monday morning, June 23, at 10 o'clock, in the auditorium of the Central theater. The King of Saxony was present. On the platform were the Staatsminister of Saxony, Count Vitzthum von Eckstädt, Second Bürgermeister Roth (in place of the absent Oberbürgermeister Dittrich), Rektor Bruns of the University of Leipzig, Rektor Förster of the State Technical College at Dresden, Count Zeppelin, Dr. Rudolph Diesel, and other notabilities, besides the leaders in the Verein and the Society. Dr. Oskar von Miller, President of the Verein, was in the chair.

After the formal opening words of Dr. von Miller, the State Minister made an address which expressed a very high appreciation of engineering, or more properly "Technik." Prof. Max Förster then announced that the Technical College at Dresden asked the King to accept its bestowal of the degree, Doctor of Engineering, *h.c.* Further formal but significant addresses were delivered by Rektor Bruns, K. Sorge (Essen) of the Council of the Verein, and (in response) by Acting-President James Hartness of the American Society.

PRESENTATION OF THE GRASHOF MEDAL TO GEORGE WESTINGHOUSE—Dr. von Miller then announced that the Council of the Verein had chosen George Westinghouse as recipient of this year's Grashof Medal. He declared that this was independent of the Society's visit, as the honor attached to the medal is such as to forbid its use for gracing an occasion. But because of the coincidence of the Society's visit the medal was delivered to the Acting-President for presentation to Mr. Westinghouse.

The brief review of Westinghouse's achievements which Dr. von Miller gave in the course of his remarks was precise and discriminating, not least so in its closure, which gave special encomium to Mr. Westinghouse's personal qualities.

COMMEMORATIVE TABLET—A fine tablet of bronze was presented to the American Society by the President on behalf of the Verein. A silver plate on the tablet carries an inscription of welcome to the Leipzig meeting, including expressions of respect and friendship. Later, Count Zeppelin spoke briefly, amid great applause.

The meeting then listened to the presentation of the technical papers: "Die Technik und Kultur der Gegenwart," by Prof. Lamprecht of the University of Leipzig, and "Foundations of American Engineering, by Prof. W. F. M. Goss, of the University of Illinois.

On the afternoon of the same day, a splendid orchestral concert was given in the great hall of the "Gewandhaus," Otto Lohse conducting. Immediately afterward the party assembled at the Central theater for a formal banquet, followed by a ball lasting until dawn. The banquet courses were interspersed with speeches and musical numbers, the latter including a series of songs by the famous Thomaner choir of boys, lineal descendants of the choir led by Bach. The banquet wound up near midnight in a blaze of patriotism and good fellowship—German, American and joint.

On Tuesday morning, June 24, the second and final session was held in the Baufach Ausstellung (Architectural Exposition). At this session business proceedings of the Verein occupied some time, and then two further papers were presented: "Industrial Management," by James M. Dodge (Philadelphia, Penn.), and "Praktische und Wissenschaftliche Betriebsfuhrung," [Practical and Scientific Management] by Prof. G. Schlesinger (Berlin). These papers were of high interest to the German as well as the American engineers present, and active discussion developed. This was wholly by the Germans, however; in the absence of interpreters to translate the discussions, most of the Americans were unable to follow the argument closely enough to take part. A short summary of the discussion is given below, following notes on the two papers.

The remaining half day of the stay in Leipzig was used for an inspection of the Architectural Exposition, a visit to the vast and impressive "Völkerschlachtdenkmal,"* south of the city—a centenary memorial of the great battle of Leipzig—in which the allied nations of central Europe broke the power of Napoleon—and, as the closing feature, a wonderfully arranged evening party at the "Palmengarten," where the evening was seasoned with military band music, song renderings by the Leipzig Männerchor, and fireworks. A "festival of the Summer Solstice" (a "Sonnenwendefeier") planned as part of the evening, was spoiled by heavy thundershowers.

MODERN TECHNICS AND CULTURE

Prof. Lamprecht's paper, the work of a historian, based its argument on lofty historical and philosophical considerations. It advanced the idea that engineering is now a mature art, or is in its classical days, and based the further discussion on this fact.

> **Technics of today must be regarded as essentially the last and highest expression of the development of mechanical natural science. The position, then, of technics in the whole progress of European culture of today is determined. Modern technics is not a domain in which new and important results can be obtained by prophetic intuition and mere romantic ideas. . . . It is no embryo, but a well developed, beautiful and vigorous being at the height of its activity. It possesses virility and force, and so is in its way classical. For we must designate as classical such manifestations of human life as do not belong to the more romantic beginnings of a new life, but bring to an end the matured life-experiences of earlier generations—an end which may appear to contemporaries as, in human judgment, complete, or even, with some enthusiasm of thought, as one of eternal duration.**

Thence proceeding with a profound analogy between the development of engineering and that of pictorial art, the author led up to the assertion: "Technics of today has passed the first phase, the mere naturalistic motive, and has now reached the level of the second phase, that of idealistic achievement." The nature of this achievement, the author then suggested, is *qualitative production.* He quoted from the latest book written by the Crown Prince of Germany, and also from President Wilson's inaugural speech, views in support of his thought, including the following from Wilson:

> **Our thought has been, "Let every man look out for himself, let every generation look out for itself," while we reared giant machinery which made it impossible that any but those who stood at the levers of control should have a chance to look out for themselves. . . . We were very heedless, and in a hurry to be great. . . . We have now come to the sober second thought. . . . We are now entering upon a time of further consideration, when these things shall be dispassionately deliberated upon.**

The author finally expressed his important deduction thus:

> **It is in the development of technics and modern industry themselves that we must look for an expedient for removing the moral and social evils which have been called forth through a brilliant material progress. No superficial suppression of these evils, no political revolution, can have any last-**

*To be completed by the coming fall.

ing effect in attaining this end, but only the moral self-purification of industrial development in itself. It is upon the engineer that an extremely important task of the present, and one which will certainly continue into the fairly remote future, will devolve. The humanizing of modern labor, that quantitative production may be transformed into qualitative production. An increasing improvement in the moral relations of employers and workers, a reconciliation and humanizing of the advancing social classes generally, the evolution of a nobler society and a nobler state, would, then, be not the sole but the chief consequence of a movement whose accomplishment rests in the engineer's hands.

This somewhat Kantian address was followed by that of Dean Goss, entitled, "The Foundations of American Engineering." This was a general review of the social and economic and commercial conditions which have influenced the development of American engineering, especially in recent years.

These two papers, coming at the formal opening session, were not discussed. The two papers on Industrial Management, by J. M. Dodge and Prof. G. Schlesinger, at the second session were discussed very actively. In fact, the interest displayed in the subject was so general and thorough that a full session could have been employed in the discussion. It is to be noted that reading the papers in full consumed much time which otherwise would have been useful for the discussion.

Industrial Management

Mr. Dodge's paper in effect presented some new definitions of "scientific management," of which the two following are specimens:

Scientific management in its highest development has to do with the plant or industry in its entirety, increasing the earning power without disturbing the percentage of the gross profit which goes to the wage earner as compensation and to the proprietor as net profit, and increasing the momentary return to each without any change in these percentages, or without either party benefiting to the detriment of the other.

In its essence, scientific management involves a complete mental revolution on the part of the working man engaged in any particular establishment or industry—a complete mental revolution on the part of these men as to their duties toward their work, toward their fellowmen, and toward their employers. And it involves an equally complete mental revolution on the part of those on the management's side—the foreman, the superintendent, the owner of the business, the board of directors—a complete mental revolution on their part as to their duties toward their fellow workers in the management, toward their workmen, and toward all of their daily problems. And without this complete mental revolution on both sides scientific management cannot exist. . . . After this is accomplished, nothing is left but the arranging of the mechanical and clerical details, which can be readily and satisfactorily done. . . . So far as methods of time-keeping, pay, time-study and all that goes with it are concerned, no one of these details is absolutely essential. All may be modified, provided that in making the modifications positive conflict with other details is not developed. All must be done with a broad understanding, and with the spirit of absolute faith in the outcome and confidence in the triumph of truth over error.

Mr. Dodge's paper was, as would be expected, a strong defense of the Taylor system. Prof. Schlesinger's, on the other hand, was a critical discussion of the subject. Adopting F. W. Taylor's statement of the elements of management, he first gave a full review of the question of selecting the workers. He mentioned two papers on work and fatigue published by E. Kraepelin, of Heidelberg, in 1894 and 1896, and cited Kraepelin's principles on which the study of mental capacity should be based; these, he said, are remarkable in their agreement with Taylor's line of thought. Schlesinger indicated complete acceptance of the belief that workmen should be selected for fitness on the basis of scientific study of their elementary qualities. He next reviewed the methods advocated for determining the optimum conditions and methods of a piece of work, especially the recent moving-picture method and the like, again implying full approval. He then considered and refuted some of the various objections raised against the Taylor methods; for example, he strongly opposed the claim sometimes made by workmen that they should receive all (or most) of the gain realized, and the claim that the Taylor system is bad because it is a driving system. Finally, however, Schlesinger parts from Taylor by saying that scientific management "ends when the division of work, study of time, normalization, systematization, instruction and training of the workmen for the new method of work have been accomplished. The payment itself can be made in any way desired, so long as it is just, and so conforms with the workman's average."

As to the practicability of introducing scientific management in Germany, Schlesinger expressed a most optimistic view. He said that the recent putting of all railway employees on a modified piecework basis, covering shops as well as road, really gives Germany the distinction of having a far larger number of men under scientific management than the 50,000 in the United States.

Discussion of the two papers on industrial management was practically confined to the Germans; of the Americans, only H. L. Gantt spoke, briefly stating the view that scientific management, in its best form, is merely the securing of such an arrangement of individuals and duties that the man who knows (or can find out) teaches the man who does not know.

The German discussion evidenced intense interest in the subject, but also showed that advocates and opponents divide much as they do in America. The very first speaker, C. Matschoss, was optimistic on the harmonizing of labor and capital, but skeptical as to the ability of "scientific management" to meet certain essential needs of the present situation. The welfare idea has already fallen, being objected to by the workers as involving charity. A moving thought among workmen is provision for old age, which must be met by any really satisfactory scheme of management. The essence of the subject, he considers, lies in questions of the workman's state and its relations to efficiency and to the employer's interests. That the mere study of elementary operations, and issue of precise instructions for them, is not a novelty can be seen, for instance, in the army firing instructions, which consist of minutely detailed instructions for every movement involved in firing the rifle.

Two following speakers displayed pessimism and optimism. The first protested against Dodge's attempt to make "scientific management" synonymous with a spirit, as meaningless, and further asserted that various objections against the Taylor ideas remain unanswered, e.g., the objection that the workman's interest cannot be secured permanently for the performance of tasks which in precise repetition become a monotony. The next speaker held that all discussion of the relations between employer and worker is beneficial, tending to bring the two sides together, and to illustrate this he stated that the publication of the society's monthly paper devoted to administrative questions, "Technik und Wirtschaft," had not increased the hostility between employer and worker (as had been feared), but has decreased it.

Provision for the old worker was again taken up by

the following speaker, on the claim that the Taylor principles, if applied strictly, call for the discharge of the aged workman. He suggested that any increase of production secured by the new management should be taxed for taking care of the retired worker. Becker, a later speaker, on the contrary, claimed that the aged (and less efficient) workman would not be discharged but would merely earn a lower wage than he earned in his prime. Another member, Grund, suggested that the workmen whose productive efficiency decreases from age would find natural employment as instructors, planners, ratefixers, etc., required under scientific management.

E. W. Koester (of Pokorny & Wittekind, Frankfurt a. M.) said that a management system substantially identical with the Taylor system was put in force in one of their departments seven or eight years ago, and has been a great success. When strikes occurred or were threatened in other departments, this department was always excepted. However, in his opinion the system could not be introduced into the same shop today, when the subject has come to the knowledge of laborers and has become a matter of animated partisan discussion.

These excerpts from the discussion suggest its general trend; favorable and unfavorable opinions being held and energetically defended, much as in America (though with differences in the details of the argument).

A STANDARDIZATION LABORATORY—A matter suggested in Prof. Schlesinger's paper was the desirability of having a single institution, bureau or laboratory which would determine for all manufacturers those data, or methods, or time-allowances for given items of work, which are independent of local and special conditions. Prof. Schwerdt, of the Hannover Technical College, made the interesting statement that this desideratum is shortly to be supplied. A laboratory is now being built at the Hannover school which is intended for carrying on just these functions. Unfortunately, he did not give details about scope or methods.

F. E. S.

Dresden, June 25.

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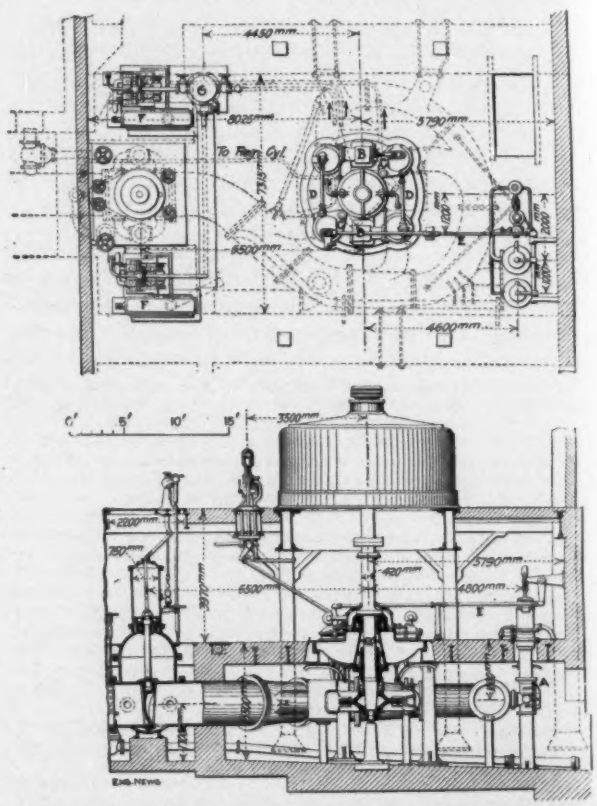
A 19,000-Horsepower Vertical-Shaft Pelton-Type Waterwheel Under 1015-Ft. Head

Two 19,000-hp. vertical-shaft Pelton-type wheels of the design shown in the accompanying figure have recently been completed for the Pirahy power station of the Rio de Janeiro Tramway, Light and Power Co., of Brazil. This plant is about 50 mi. from the city, on the River Lages which, above the station, drains an area of 193 sq.mi., having an average rainfall of 59 in. per year. The station is located at the foot of a declivity where the river in a short course drops nearly a thousand feet. At the upper end of this run, an arch dam, 138 ft. high and 656 ft. along the crest, has been built, forming a storage lake 17 miles long.

At this station 50-cycle current is generated at 6000 volts, being stepped up to 80,000 volts for transmission. Prior to the installation of the two machines, the station main equipment comprised six 8700-hp. impulse wheels.

With the new equipment, the machine section has two floors above the tailrace level, the upper of which forms the generating-room floor and carries the alternators, generators and control handles. The runner to which the buckets are secured is keyed to the bottom of the vertical shaft and this is supported on a pedestal and has two guide bearings, one just above the runner and one at the base of the generator frame. The casing around the runner carries four needle-valve nozzles arranged symmetrically in a horizontal plane. The distributing pipe leading to the nozzles has the form of a spiral, and is connected to a pair of relief valves at the tailrace end (shown at the right of the accompanying figure) to limit the pressure rise under sudden load changes. These valves have sufficient capacity to allow full-load flow of water to pass, and are operated in conjunction with the nozzle regulation. The nozzles are built independent of



INSTALLATION PLAN AND ELEVATION OF 19,000 HP. VERTICAL-SHAFT PELTON-TYPE IMPULSE WATER WHEEL

(Built for the Rio Janeiro Tramway Light & Power Co., by Escher, Wyss & Co., Zurich.)

each other, but are governed together by two oil-cylinder pistons ("servo-motors") to change the nozzle area to correspond with the load.

The crosshead of each piston is connected to the crank of a vertical rocker shaft and by a horizontal bell crank to a horizontal oscillating link rod, the other end of which is connected to the crank of the rocker shaft for the next needle. The two pistons are interconnected by cranks and a link rod, so that they move in unison. Their motion is conducted by a crank and reach rod to the relief valves, which are opened after the needles have closed to a predetermined point.

These wheels were designed and built by Escher Wyss & Co., of Zurich, Switzerland.

EDITORIALS

The INDEX to ENGINEERING NEWS, Vol. LXIX, January-June, 1913, will be mailed with our issue of next week, instead of with this issue as previously announced.

Common Sense Concerning Concrete Road Paving

We strongly recommend to all of our readers in any way interested in street paving and roadway construction the interesting article describing the experience of Kansas City in concrete street paving written by Mr. Clark R. Mandigo, Assistant City Engineer, and published elsewhere in this issue.

Let us say at the outset that we share the opinion, held we believe by most engineers who are thoroughly posted on road construction and street paving, that a large proportion of the work which has been done in the past half-dozen years in the laying of concrete street paving in various cities has been a mistake or worse than a mistake. A great deal of the concrete street paving which has been put down in accordance with some patented special formula has, according to the best of our information, proved a dismal failure, as was indeed predicted by competent engineers when the work was undertaken. We frankly confess also to a large amount of skepticism concerning the sweeping claims made for concrete as a paving and roadway material in much of the widely circulated good-roads literature. The great bulk of this sort of material put forth for booming concrete roads bears the plain earmarks of inspiration by commercial interests, and commercial interests, moreover, who have not had good sound technical advice. The really competent business man who knows his business understands perfectly that it is the greatest mistake to try to sell his goods, whatever they may be, for a use in which they will not give satisfaction.

We have long held the opinion that concrete, if properly made and properly laid, and for use in certain locations, might make a most admirable and successful road surface; but a large proportion of the concrete roadways which have been put down have neither been properly made nor properly laid, nor have they been placed in locations for which concrete was suited.

Mr. Mandigo's article in this issue, however, will appeal to the reader, we are sure, as it appeals to us, as a sound, common-sense view of the merits and limitations of concrete as a road material. The specifications under which concrete pavement is now laid in Kansas City, moreover, impress us as most admirable. They describe exactly the way concrete ought to be laid if it is to withstand the wear and tear of street traffic; and city authorities who have misused their taxpayers' money by paying royalties for laying concrete in various wrong ways will do well to study with care these Kansas City specifications.

We would emphasize still further that the success of concrete paving depends more than anything else on the way in which the work is done. We venture to say that if an engineer who knows what really first-class concrete is will take a tour around various pieces of construction work where concrete is being mixed and placed he will not find one place in ten where there will not be something to criticize in the way the concrete is being handled.

It is, of course, held up as one of the virtues of concrete that it will stand so much abuse. It can be mixed too wet or too dry, with its ingredients carelessly measured and more or less variable in proportion, the mixing may be very imperfectly done and more or less dirt and street offal may find its way into the finished mass, yet for many places where concrete is used the finished concrete will show up all right. When we come to the use of concrete for street paving, however, we have a case where the best is none too good, and very fortunately it costs only a trifle more to lay concrete in a first-class manner than it does to lay it in the usual slipshod, slovenly way.

A point worth special emphasis in connection with concrete paving is that the revolution in traffic conditions through the change from the horse to the automobile which has gone on during the past half-dozen years is very greatly favorable to the use of concrete construction. It will generally be agreed that the place where concrete paving will be most apt to show rapid wear is where it is subjected to the impact of horses' hoofs and heavily loaded steel-tired wheels. With rubber-tired vehicle traffic, however, a smooth concrete surface should show very little wear; and on roads, now becoming increasingly numerous, where automobiles form the great bulk of the traffic and horses and steel-tired trucks are few, a concrete paving surface should, if laid in the best manner, show most excellent results.

An Important Reclamation Service Decision

Among the numerous efforts to lessen or shift the water charges assumed by purchasers of land under the United States Reclamation projects is one to avoid payment for the annual maintenance charges of the irrigation works which supply water. The United States Supreme Court recently rendered a decision which establishes once for all the legality of the maintenance charge.

One might suppose that after the Government had sold a man land at nominal cost and provided him water for irrigating the land at the actual cost of constructing the works, the government advancing the money for such construction and allowing the land buyer to repay this cost in ten annual installments, without interest, that there would be no protest against the small yearly additional charge necessary to maintain the irrigation works until such time as the works were fully paid for by the land owners and turned over to them for maintenance. This supposition would be all the more reasonable in view of the fact that the cost of constructing the works

which is repaid to the Government goes into a revolving fund for the building of still other works.

But "he who gets wants," especially when federal lands and funds are concerned, or else so large a part of our once almost unbounded natural domain would not have wrongfully gone into private ownership through both congressionally legalized and plain stealing. Demands exactly similar in spirit are now being made of the government with reference to the lands under the United States Reclamation Service, and with these demands there is too often much mudthrowing at the engineers and other officers of the United States Reclamation Service.

Fortunate as is the decision noted, it doubtless will not end the efforts of the settlers to evade payment of maintenance charges, and if possible, to get rid of any payments whatever for irrigation works. The raid will very likely be carried to Congress sooner or later, but it should there meet with prompt and complete defeat.

It is of interest to note that in its decision the Supreme Court pointed out the perfectly obvious fact that the revolving irrigation fund would cease to revolve and finally vanish if maintenance charges were paid from it. It is revolving or being replenished slowly enough already, through the backwardness of many settlers in paying their annual installments for their water rights.

A Pertinent Illustration

It seems to be an inherent tendency of our form of government to disregard the value of experience; any man is considered good for any job; all he has to do is to get the votes, by one means or another. Men who have made little or no study of government, and who have had no experience in it, are considered capable of judging of and administering laws and of occupying any elective or appointive position. The butcher, the baker, the candlestick maker, are all eligible for the state legislature, for congress, for the senate, for the mayoralty or the presidency. This condition necessarily results in gross inefficiency and waste, not always through evil intent, but perhaps more often through stubbornness, ignorance, conceit or the unwillingness or inability to select and take good advice. Not until our legislators and our administrators of public affairs are chosen from men trained and experienced, and who have ascended from the bottom step by step, will efficiency, economy and wisdom be attained in our government. (From the Presidential Address of Dr. Geo. F. Swain at the Ottawa Meeting of the American Society of Civil Engineers.)

For the two vacancies in the Public Service Commission for the Second District of New York, Gov. Sulzer has named Charles J. Chase, of Croton-on-Hudson, and William E. Leffingwell, of Watkins. So far as known to the public, and also so far as appears from Gov. Sulzer's statements concerning these nominations, the men have no qualifications marking them out as fitted for the high responsibilities that attach to the office which they have been designated to fill. Mr. Chase is a locomotive engineer on the New York Central Railroad, and the Governor states that he is nominated "in accordance with the promise made by the Democratic party in its platform adopted in the last State Convention, as follows: "'We favor the appointment of a practical railroad man as Public Service Commissioner.'" Mr. Leffingwell is the proprietor of a hotel and resort at Watkins, and Gov. Sulzer's statement concerning his qualifications is as follows:

He has always been an active Democrat, and has never shirked responsibility to public welfare, to which he has given freely much of his time. He has held many minor offices, such as village trustee, village president or commissioner of water, sewer, and electric lights. In 1904 he was the nominee of his party for Presidential elector, and in the following year was elected member of Assembly in a district usually Republican. In 1912 he was again elected as Presidential elector.

If either of these gentlemen had given evidence of qualifications for the office of Public Service Commissioner other than those above stated, it may be assumed that Mr. Sulzer would have mentioned them. As it is, we have to conclude that the Governor of the State of New York, instead of endeavoring to secure for the people, in two of the most important posts in their government, the most competent service that could be obtained for the handsome salary of $15,000 a year, has deliberately treated those offices as favors to be granted with very little reference to fitness. From this point of view, the reasons he assigns for the appointments may be good enough; from the point of view of the qualifications properly belonging to the office of Public Service Commissioner, their absurdity is too apparent to call for any analysis.—New York "Evening Post," July 9.

The appointment by Governor Sulzer of a locomotive engineer to be a member of the Second District Public Service Commission, is nothing short of disgraceful.

Mr. Chase may be a highly competent and faithful engineer. He may be a man of intelligence and high character. It is nothing against him if he is not qualified for so high a public office and one requiring analytical power and keen and independent judgment on complex questions. It is simply impossible that, with the kind of experience and training that he has had and the position he occupies, he should be so qualified.

It is no compliment to the workingmen of the state to assume that their support is to be bought for a political party by such an offer of a share in the spoils as this implies. They know as well as anybody that a locomotive engineer is not qualified to serve as a Public Service Commissioner, and, though they cannot be expected to object to such an appointment, they ought to scorn the motive of it.—"Journal of Commerce."

President Wilson has just announced the appointment of Ephraim Doeshank, of Habbakuk Corners, New York, to succeed Col. Goethals, in charge of the operation of the Panama Canal. Mr. Doeshanks has been for twenty years Captain of a canal boat on the Erie Canal and the President is convinced that public opinion demands that a practical canal man should be placed in charge of operations at Panama.—Imaginary news item in the Washington "Busy Bee," of July 4, 1915.

Two Reports on the New York, New Haven & Hartford Railway Co.

The Interstate Commerce Commission issued last week two reports of unusual interest, one summarizing its investigation of the rear collision of June 12, at Stamford, Conn., on the New York, New Haven & Hartford R.R., the other reporting the results of the investigation which has been in progress for a year or more, regarding the general conduct of financial and other matters by the New Haven company.

The main particulars concerning the Stamford accident and the facts developed by the investigation, have been already reported in these columns. The Commission summarizes them in its report, and reaches the following conclusions:

1. The engineman of second No. 53 did not have the special experience and instruction required for the operation of such a train.
2. The New York, New Haven & Hartford R.R. Co. had no reliable method for determining the capacity of enginemen before placing them in charge of high-speed passenger trains.
3. There was negligence on the part of the corporation in putting in charge of such a train as second No. 53 an engineman inexperienced and uninstructed for this class of work.
4. This railroad has no proper system of checking work reports so as to determine whether or not defects reported on locomotives are actually repaired. This lack of supervision is dangerous and it ought not to be permitted to continue.
5. The distant signal at Stamford is too near the home signal, and should be at least 2500 ft. distant therefrom.
6. Modern steel equipment for high-speed passenger trains should be installed at the earliest possible time, as recommended in previous reports of this Commission, and legislation fixing such a time should be enacted without delay.
7. Establishment of safer and more efficient operation of this railroad is immediately necessary if congressional legislation extending the scope of governmental regulation of railroads is not to be called for and justified in the interest of public safety.

There can be no question that, reviewing the evidence on its face, the conclusions of the Commission appear to be fully justified. There are, however, other considerations which must fairly be taken into account in deciding to what extent the management of the railway company can be considered culpable.

In the first place, it is easy to be wise after the event. It is easy to review the working of any organization after a failure or accident has occurred, and going analytically step by step through the various acts of the different parties concerned, to determine just where the weak spot lay. But the problem of the responsible railway officer is a far harder one. It is his task to take an actual working organization, dealing with hundreds and thousands of human, fallible men, subject to all the frailties and faults that are inseparable from human nature, and to attempt to so organize and train and discipline these men as to obtain not only safety but efficiency, economy, regularity, and, last but not least, a contented and reliable set of men.

Take, for example, Commissioner McChord's criticism of the railway company that it has no proper system of checking the reports of defects made by engine runners to see that they are actually performed. Considered in a theoretical, abstract way, it would seem to be proper and businesslike if every defect reported by an engineer were given a systematic record, and if this were followed up by a record as to what work was actually done to comply with the engineer's report.

It is one thing to plan such a system and order it adopted. It is quite another thing to actually carry such a system into practical, *useful* effect. An incident of this special case illustrates, to anyone who reads between the lines, just what the situation is, with respect to such engineers' reports.

It appears that Dougherty, the engine runner who caused the disaster, had on a previous run, gone past the station platform at Bridgeport before his train came to a halt. It is clear from the exhaustive tests made, after the disaster that this was not the fault of the brake equipment, but because Dougherty was not sufficiently used to handling high-speed, heavy trains, to apply the brakes soon enough so as to bring his train up to the station under control. Probably because he wished to have some defense, in case he was criticized for running past the platform, Dougherty wrote on the "work book" when he brought his train to the terminal, "Brakes no good." He did not at all specify what was the matter with the brakes, wherein they were "no good," nor did he explain to anyone what he meant by this entry.

Of course, those who pin their faith solely to systematic written reports and records will say that Dougherty should have specified exactly what the matter was with the brakes, according to the best of his knowledge; but any railway officer, experienced in the actual handling of men in the mechanical department, knows how difficult it is to get them to put down in writing, clearly and definitely, what their ideas may be on any subject. To a certain extent, at least, this is not their business. Few locomotive engine runners of the present day are, by any means, expert in all the details of the complicated machine under their care; and to get them to put down their complaints in more than general terms, would be well nigh hopeless.

It appears, moreover, that Dougherty's complaint was not neglected. The shop repairman saw it on the books, looked the brakes over and tested them, but found nothing the matter with them. That he was correct is fully proved by the reports of the various air-brake experts who went over the locomotive thoroughly after the disaster. Except for a slight irregularity in the pump governor, the locomotive brakes were in perfect condition. From the testimony of Dougherty himself, when properly analyzed, and from the results of the test actually made with the train after the accident, it is entirely clear that the brakes which Dougherty called "no good" in his written report were in fact all right, and that the only trouble, and the only cause of the accident, was that Dougherty did not apply them sufficiently soon to stop his train.

If the shopman had been required to render a written report of what he did with reference to Dougherty's complaint, the accident would have been in no way averted, nor does it seem clear that there is any real safety feature in such a requirement. If a shopman is so unreliable that he will neglect repairs which affect the the safety of the locomotive, he is unreliable enough to fill out a card reporting work done which has not been done.

The Commission, in its report, lays great emphasis on the need of special care in selecting the engine runners for fast express trains. There is a certain justification for this in the actual practice of railways, without doubt, but the soundness of its foundation may be questioned. Local passenger trains and suburban trains often attain quite as high speed between stations as do the fast expresses; and the conditions under which they are run, with respect to other interfering trains and so on, often make a greater demand on the intelligence and responsibility of the engine runner than are made on the runner of the through express trains, to which everything has to give a clear right-of-way. The fidelity and ability of the engine runners on freight locomotives, also, are scarcely less important to the safety of passengers and employees. The worst disaster for many years on the Lackawanna Railroad, was the rear-end collision near Corning, N. Y., a year ago, when a freight train crashed into the rear of a through passenger train, having run past two block signals set against it, and the rear flagman, stationed far back behind the standing train. Such instances of disaster to passenger trains caused by freight engine runners could be multiplied without number.

On the general proposition that greater care should be exercised in the selection, training and discipline of engine runners, and indeed of all responsible operatives in connection with train movement, intelligent railway officials will be in hearty agreement with the Interstate Commerce Commission. They appreciate, however, that to do this in the way it should be done is not a matter of mere form of organization or rules or reports. It is not a thing which can be established in a month or even a year. To build up a model railway organization, or an organization in any other occupation or industry, for that matter, must be a matter of normal growth. The men must be brought together, trained, and accustomed to work with each other, and there must be a willingness to spend sufficient money to secure a class of strong, capable and intelligent men, to lead and supervise the workers in the ranks.

This is the ideal, not only for railways but for every organization where large and permanent results are aimed at. It has been one of the unfortunate developments of the era of high finance and of the transfer of industry from a localized control to a centralized control, that the value of the men constituting an organization and the knowledge they have acquired by long years of experience has been far too often overlooked.

The question which is being asked, not only in the newspapers but in railway circles, is whether such defects as have been uncovered on the New Haven road by this investigation, may perhaps be traceable to the career of high finance which the interests in control of the company have for the past 10 years been pursuing.

Commissioner Prouty, in the other report referred to at the outset of this article, reviewing the whole subject of railway development in New England, says: "The outside financial operations of the New Haven Co. for the last nine years have been wasteful in the extreme, and the methods by which those operations have been conducted are unnecessarily involved and complex." As is well known, a committee of stockholders of the New Haven Co. is now engaged in a minute investigation of the various methods by which the capitalization of this corporation, which was only $93,000,000 ten years ago, has been increased to $417,000,000. For this enormous increase in capital, the company can show only 50 miles more of roadway; and while a large part of the increase has been expended for improvements of a permanent nature upon its own line, the bulk of it has gone to buy street railways, steamship lines and a varied assortment of properties which are yielding today a very small return upon the money spent to acquire them. Judged by the results to its stockholders, the New Haven financial policy of the past decade has been a financial crime. The stockholders have a right to inquire, and doubtless will sift to the bottom the question what were the motives for purchasing these unprofitable properties, at enormous figures, and for making the transfers by a devious, complex and tangled web of financial and legal obligation, that even an expert can hardly untangle. Were all these vast financial transactions carried on for the benefit of the company's stockholders or for those holding an inside interest who were able to control the company's policy?

It is at this time interesting to recall the flattering newspaper reviews which have appeared at various times during the past 10 years, lauding the broadminded and liberal policy of the New Haven management, and contrasting it with the "old fogy" notions which prevailed during the previous administration of the company. Viewed in the light of present knowledge, the stockholders of the New Haven Co. are inclined to look with regret on the abandonment of the "old fogy" methods and to deplore the day when the New Haven Co. made the business of running a railroad secondary to the business of purchasing, at a high price, all the transportation lines in New England.

The Interstate Commerce Commission's report on the New Haven Co. has far more than local significance. If the methods of high finance can prevail in the conduct of New England railways, where the control is exercised by the bankers and financiers of highest reputation and standing, then the public and the stockholders of the railways themselves are likely to demand a further measure of Government control and supervision.

What the Interstate Commission itself thinks as to the lessons to be drawn from the New Haven investigation, is summarized in the following quotation:

> **In the opinion of the Commission the following propositions lie at the foundation of all adequate regulation of interstate railroads: (a) Every interstate railroad should be prohibited from expending money or incurring liability or acquiring property not in the operation of its railroad or in the legitimate improvement, extension, or development of that railroad. (b) No interstate railroad should be permitted to lease or purchase any other railroad, nor to acquire the stocks or securities of any other railroad, nor to guarantee the same, directly or indirectly, without the approval of the Federal Government. (c) No stocks or bonds should be issued by an interstate railroad except for the purposes sanctioned in the two preceding paragraphs, and none should be issued without the approval of the Federal Government.**

LETTERS TO THE EDITOR

An Objection to the Reported Cost of Water Rights under the Carey Act Projects

Sir—Your issue of May 15 contains an interesting article on "The Cost of Irrigation Works per Acre Supplied with Water." Having been in direct touch with the question in the case of Wyoming irrigation projects, it seemed to the writer that the cost of the water rights under the Carey Act projects was reported at too high a figure.

Consequently the writer investigated the charges made by four of the companies operating under the Carey Act. Four typical projects were selected. The Boulder Canal project is one of the older ones and at a considerable distance from the railroad. The Uinta County Irrigation Co. project is a recent one, being at about the same distance from the railroad as the Boulder Canal. The La Prele Ditch and Reservoir project lies close to the Chicago & Northwestern R.R., and right across the river from the town of Douglas. The Wheatland Industrial Co. project lies close to the Colorado & Southern R.R., near the town of Wheatland. The last two projects are comparatively recent. Both depend largely on reservoir water, which makes the cost somewhat greater than in cases where it is not necessary to store water.

In the following table, column 1 gives the name of the project; column 2, the number of acres that have been contracted for under the Carey Act; column 3, the average price per acre for water rights for Carey Act

land; column 4, the price for water rights as given in the Reclamation Service tables.

Project	Acres	Price of Water Rights per Acre Average	Maximum
Boulder Canal Co.	4200	$12.80	$30.00
Uinta County Irrigation Co.	3700	25.00	35.00
La Prele Ditch and Reservoir Co.	3950	25.75	50.00
Wheatland Industrial Co.	880	36.75	45.00

The amounts in column 4 are the maximum charges allowed for Carey Act lands in that particular project. This maximum price is fixed by the State Land Board, and may not be exceeded for Carey Act land. It is not customary to charge the maximum price except for lands that are particularly attractive. As the lands are sold for the uniform price of 50c. per acre, the charge for water is made such that the total charge for land and water will be proportional to the value of the land.

If the figures, given in the Reclamation Service tables, for projects in the other western states, are as far off as those for Wyoming, it would appear that very little dependence could be placed in them.

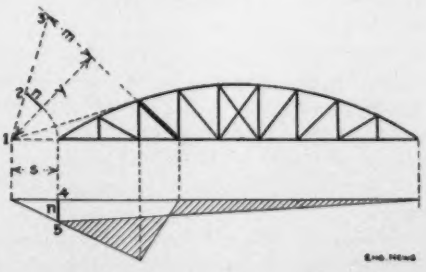
The maximum maintenance charge on any Carey Act project in Wyoming is fixed at 40c. per acre, so long as the system is operated by the construction company. As the maintenance charges on Reclamation Service projects in Wyoming are $1 or more per acre, the excessively substantial construction hardly seems to have been worth while.

H. G. WATSON.

Cheyenne, Wyc., June 17, 1913.

A Suggested Addition to the Method of Drawing Influence Lines for Stress in Simple Trusses

Sir—I have read with interest the article in your issue of June 12 entitled "General Method of Drawing Influence Lines for Stress in Simple Trusses" by Malverd A. Howe, and I suggest that Prof. Howe might well add the following method of transforming his moment influence lines to influence lines for stresses?



Referring to his Fig. 1a, which is here reproduced, prolong the line representing the member whose stress is desired and from the foot of the perpendicular *y* lay off the distance *m*, equalling 20, 50, 100 ft. or as convenient and draw line 1-3; swing the arc of the radius 5 and obtain line *n*. Now lay off line 4-5 equaling *n* (instead of distance *s* as given for moment) and complete the diagram as described for moments. The resulting influence line will give the stress in the member due to the unit load. The scale of the ordinates will be that of 5 divided by *m*. If the truss is drawn to the scale 1 in. = 20 ft., *m* may perhaps be 20 ft. and a 10 scale used for measuring stresses, or 1 in. = 1 lb.

C. A. MELICK.

Michigan Agricultural College, East Lansing, Mich.
June 14, 1913.

Concerning Engineering Research—The Useless and the Useful

Sir—The editors of ENGINEERING NEWS are to be congratulated on the increasingly progressive and original nature of their editorials, one of the most recent evidences of which is the able editorial with the above title, which appeared in your issue of July 3, 1913.

While this subject is by no means original, it is one which is not given the serious consideration that it deserves at the hands of practicing engineers, who are only too eager to grasp at the least bit of experimental data when necessity demands. Until such time, however, their attitude toward engineering research is about as complacent as that of the man who doesn't need shingles on his house because it isn't raining.

In the above mentioned editorial, research is placed in two classes—the "useful" and the "useless." The writer would add a class between these two and call it the quasi-useful, and define the three as follows:

(1) Useless research—That which has no recognizable or immediate bearing on practical engineering knowledge, and cannot be used to further any known cause.

(2) Quasi-useful research—That which is published in such form, and complicated with such a mass of mathematical manipulations or abstruse statements as to make it available only to accomplished mathematicians, or that requires great concentration and much time to arrive at the meat of the matter.

(3) Useful research—That which has direct application to engineering work, and can be made use of by the practicing engineer without reviewing all the elementary principles of his engineering education.

Publications of the first class have no interest whatever for engineers and do not generally appear in the technical periodicals, or transactions of engineering societies. Papers of the second class often appear in such publications and are generally read in a haphazard fashion, or not at all; and if read are generally laid away with the unsatisfactory feeling that they contain much material of value but not available for use, because there is no time for extracting the useful portion from the mass of worthless or abstruse statements. Regarding the third class: Such matter is eagerly used by engineers who have immediate interest in the matter under discussion, but is passed over with only a cursory perusal by others, and in this fact lies one of the discouraging features of engineering research.

This is well illustrated by the discussions which are printed in the transactions of engineering societies. Papers giving the results of researches are generally discussed but little, while those describing works receive considerably more attention. Descriptions of work are valuable and the discussions are also valuable, but experimental data generally have a much broader application. We need not seek far for the cause of this: it is much easier to state what one's experience has been in

various problems of construction work—and the results can be dictated offhand to a stenographer, without the employment of much time or effort—than it is to criticize either favorably or unfavorably the results of experimental or mathematical research.

But this is only one phase of the question. As is brought out in your editorial, engineering colleges are doing a vast amount of research work—much of it of great value to the profession; and of late years the technical societies have carried on some original work. Why cannot some of this work be done under practical working conditions rather than in a laboratory, which, no matter how well equipped, must necessarily, in most lines, be insignificant compared with actual works? A departure along this line is illustrated by the recent bulletin of the University of Illinois Experiment Station on "Tests of Reinforced-Concrete Buildings under Load." This is a case of coöperation between a University and engineers and contractors, with advantage to both, and is a step in advance.

There is no reason whatever why college laboratories should have a virtual monopoly on research work; every large engineering work is a laboratory in itself, and only requires a little initiative and enthusiasm to bring forth data which would be of great value. Most large enterprises have at least one engineer employee who is competent to do research work of as high quality as is done in college laboratories. Furthermore, the so called "hard-headed practical man" would take more interest in data acquired in this manner. If federal, state, municipal, railroad and other engineers in charge of large works would take more interest in this matter, it is believed that results of incalculable value to the engineering profession would accrue.

E. A. Moritz.

U. S. Reclamation Service, Washington, D. C.
July 8, 1913.

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An Inherent Defect in the Time Interval System of Railway Operation

Sir—Herewith I hand you photographs of a railroad wreck which occurred on the Mobile & Ohio R.R., about two miles north of Jonesboro, Ill., on June 26, 1913. The circumstances are as follows:

The southbound local freight had stopped at the Burroughs siding to set in a car of cement for a new waterworks plant being built (on which work the writer is Resident Engineer). The local had completed its work, called in the rear flagman and was getting under way, when a double-header freight train, consisting of four cars of coal, two tank cars, five cars of crushed stone, two box cars and two caboose cars crashed into the rear of the local, demolishing the caboose and a refrigerator car next in front and throwing the next two box cars and a flat car off the track. The two engines went into the ditch on opposite sides of the track, which was torn up for about 75 ft.

About a minute later (I have no way of judging the time except from the distance an eye-witness says he ran), a third engine, without train, which was following the double-header crashed into its caboose. There is a down grade at this point and a sharp curve just back of this point.

The accident occurred about noon and these pictures were taken about two o'clock. Fortunately, no one was killed, although one man suffered severe injuries.

I am not familiar with railroad rules, and perhaps should not attempt to fix the blame, but having seen a similar accident at the same place but narrowly averted a few days before, I conclude:

1. That the rear flagman of the local either did not go far enough back, or failed to protect his train after he was called in.
2. That the third engine was following the wrecked train too closely, as there was hardly time for the flagman to get far enough from the caboose to protect it.
3. That a siding between stations, while a source of revenue, is also a source of danger.

A Double Freight Wreck on the Mobile & Ohio R.R., near Anna, Ill.

C. E. Chappell.

Anna, Ill., July 5, 1913.

[Our correspondent might have added a fourth conclusion, almost equally obvious, that such accidents are typical and inevitable under the "time interval" system of railway operation. They are happening every few days on American railways operating freight trains without any other protection than that afforded by the train dispatcher and rear flagman; but they are practically unknown on European railways where all train movements are made under protection of fixed signals.

An especially noteworthy feature is that the first train had started when the collision occurred. The "back flag" scheme of protection has no means of preventing collisions between two trains both in motion and the rear one running at higher speed.—Ed.]

NOTES AND QUERIES

Owing to an oversight the square-root sign was omitted in the formula $0.02\sqrt{K}$ on page 1331, of our issue of June 26, 1913, in a note on "An Accurate Method of Leveling with a Wye Level." This, of course, is the well known formula for limit of error. The limit for work done by the United States Coast and Geodetic Survey precise level parties is $0.017\sqrt{K}$ (error in feet, K in miles).

Harvey H. Brown, Borough Engineer of Charleroi, Penn., writes:

I should like to see discussed in "Engineering News" the relative merits of the different kinds of slag for use in foundations for brick pavements.

In this borough, slag is mentioned in the specifications by the one word, "slag," and "granulated," "bank," and "screenings" have been used in bulk and rolled to a smooth surface 8 in. thick.

Local opinion is divided as to the action of the granulated slag—whether or not it cements together or deteriorates into a muck.

The New Iowa Road Law

By A. Marston*

The Legislature of the State of Iowa passed a new road law during the winter session of 1913 which is different from the road law of any other state in important particulars. The most important features of the law are as follows:

The law creates a State Highway Commission of three persons, two appointed by the Governor from different political parties, while the third is the Dean of Engineering of the Iowa State College at Ames, Iowa, ex-officio. The terms of office of the appointive members are four years. Their remuneration is nominal, and the three commissioners constitute a board of direction to organize a staff of engineers to do most of the work of the Commission. This staff of engineers is organized on a merit basis, and their salaries and terms of service are fixed by the Commission. It is intended to secure thoroughly competent men, pay them what their services are fairly worth, and make their tenure of office depend solely upon their efficiency. The commissioners are A. Marston, Chairman, Ames, Iowa; J. W. Holden, Scranton, Iowa; and H. C. Beard, Mount Air, Iowa. T. H. MacDonald, Ames, Iowa, has been appointed State Highway Engineer under the Commission.

The office of the Highway Commission is located at the Iowa State College, at Ames, Iowa, instead of at the state capital. The purpose of this provision is to insure entire separation of the Commission from political influences and to promote engineering efficiency.

Whereas, the State Highway Commissions of most states are concerned mainly with the construction of a limited mileage of state roads, part of the cost of which is contributed by the state, the State Highway Commission of Iowa is not given any funds up to the present time for the construction of state-aid roads, but on the other hand it is given very real and extensive power over all of the road work of the state. It is charged with the supervision of the work of all road officers, amounting to between 8000 and 9000 in number and is required to enforce the road laws. The Board of Supervisors of each county is required by law to appoint a county engineer whose term of office may be terminated by the Highway Commission if he proves incompetent. Since there are 99 counties, these county engineers with their helpers and assistants and the engineers employed directly by the Commission constitute an engineering force of about 400 men all working quite directly under the State Highway Commission.

The Board of Supervisors is further required to set aside from 10% to 15% of the roads of the county as county roads. The Highway Commission is charged with the duty of passing upon this county road system, and its decision as to which roads shall be included is final. About 16,000 miles of road will be included in the county road system of the state, which will constitute a network connecting all the principal market places.

The law requires that the county engineer shall proceed to make surveys and detailed plans for the improvement of each mile of the county road system. These plans must be submitted to the Highway Commission for examination, modification and approval, and when approved become binding upon the county officers.

All bridges and culverts, whether on the county or township roads, are to be built by the counties. They must be constructed in accordance with the standard specifications of the Highway Commission, and the county engineer is required to file a detailed plan and specifications for each structure with the county auditor before work begins.

All bills for road and bridge work, except for repairs and ordinary maintenance, must be approved by the engineer, who is required to certify that the work is being done in accordance with the plans and specifications. If the engineer's certificate is not in accordance with the fact, he becomes personally responsible on his bond for the bill. The county auditor becomes personally responsible on his bond if he pays any bill without the certificate of the engineer.

As the law is working out, the Highway Commission divides the state into districts, and assigns a field engineer to each district, who visits the county seats at short intervals during the working season to confer with the county engineer, the county auditor, and such members of the board of supervisors as may happen to be present. The field engineer also examines the road and bridge work underway, and reports to the State Highway Engineer.

On the basis of the present valuation (which will probably be increased materially this year) from $2,500,000 to $3,000,000 per year are available under the new law for construction work on the county road system, or an increase of about $1,250,000 to $1,750,000 over the old law, and about $3,500,000 is available for bridge and culvert work. While the county road money can be expended only on the county roads, the county supervisors build bridges and culverts on the township roads as well.

The township road funds amount approximately to $3,000,000 per year. Under the new law each township will be organized as a single road district, and one road superintendent must be employed to take entire charge of the road work of the township. About $750,000 per year must be used for dragging the roads, and the township superintendent is required to enter into contracts for this purpose at such prices as are reasonable and

*Dean and Director of the Iowa State College, Ames, Iowa.

necessary. Probably the larger part of the remaining township funds will be used in repair and maintenance work on the township road system, but in case of all township construction amounting to more than repair and maintenance work the county engineer is required to prepare detailed plans and specifications to be approved by the State Highway Commission, and the work must be done in accordance therewith, just as in the case of the county roads.

Annual reports of all the township and county road work are to be made. The Highway Commission is required to furnish official forms for all bills, records and reports. Detailed statements of the cost of each bridge and culvert must be filed with the Highway Commission.

The new law went into effect Apr. 9, and so radically changed former administrative methods that it has taken considerable time for the road officers of the state to familiarize themselves with the new conditions. The Highway Commission has issued a 74-page Service Bulletin No. 1, containing the new law with annotations and rulings by the Attorney General. On Tuesday, June 10, practically all of the county engineers met on call of the Highway Commission at Ames for a conference as to the details of their work.

In general, the law is working out so far with less difficulty than was anticipated. It is hoped and believed that it will effect a great improvement in road conditions in the state, and that the entire system of 16,000 miles of county roads may be permanently graded and drained and covered with some surfacing material as good as gravel within the next 10 to 15 years.

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Panama Canal Excavation during June, totaled 2,659,424 cu.yd., a daily average of 106,377 cu.yd. for each of the 25 working days. The rainfall record for the month was 9.35 in. During June, 2,642 cu.yd. of concrete was laid and 111,257 cu.yd. of fill placed in dams.

A Scaffold Gave Way on the seventh floor of a building on the corner of Pratt and Greene Sts., Baltimore, July 7, injuring five men. The men were engaged in painting the ceiling on the seventh floor about 25 ft. from the floor. A section of the scaffolding broke down, dropping the men 20 ft.

A Broken Irrigating Ditch caused the wreck of a locomotive hauling a westbound train on the Denver & Rio Grande R.R. when about half a mile east of Newcastle, Colo., July 9. The soft mud and water was nearly 3 ft. deep, and the impact and the sodden condition of the track overturned the locomotive which slid into the river, where it now lies partly submerged. The engineer and the fireman were killed.

The Bonnet on an Auxiliary Overboard Discharge Valve Blew Off, flooding the starboard engine-room of the battleship "Louisiana," lying off Newport, R. I., July 2. The call for collision drill was sounded, bringing the men to quarters and automatically closing the bulkhead doors. A collision mat was put overboard and a waste can was finally forced into the opening, enabling the pumps to lower the water.

A Fire Destroyed Property estimated at $400,000, owned by the Standard Oil Co. on Constable Hook, Bayonne, N. J., July 2. An explosion in the chemical plant was followed by flames which attacked the wax plant. In addition, seven large tanks of crude petroleum and paraffin were set afire. The company's fire department was entirely inadequate to meet the emergency, and the entire Bayonne department was called upon. A southwesterly wind deflected the flames from the Tidewater Oil Co.'s plant, a subsidiary to the Standard Oil Co., thus saving further damage.

Civil-Service Examinations will be held at Albany, N. Y., July 26, for a number of important positions in the State Department of Highways, the State Architect's office and other departmental work. There are six Division Engineerships vacant and one vacancy each as Chief of Construction and Chief of Maintenance in the Department of Highways. These positions command a salary of $4000. There are nine vacancies as Superintendent of Construction and the same number as Superintendent of Maintenance. These positions pay a salary of $2500 to $3000. A more detailed account of these examinations will be found in the Construction News Department in this issue.

The Maine Public Utility Law, a synopsis of which was given in our issue of May 1, 1913, p. 912, will not go into effect 90 days after the adjournment of the legislature, as originally provided. The filing of petitions with signatures of more than 10,000 voters at the office of the Secretary of State, on July 10, asking for a referendum vote on the measure prevents the act becoming operative. The Governor may call a special election on a date from four to six months from the time he issues his proclamation declaring the law suspended, or he may designate the general election in September, 1914, as the time when the voters shall decide whether the act shall be approved or vetoed at the polls.

The 1913 Flood in the State of Ohio has been made the subject of a bulletin of the Ohio State Board of Health. This bulletin, dated May, 1913, is Volume III, No. 5 of the publications of the Board, and is entitled "Special Report on the Flood of March, 1913, prepared under the general direction of E. F. McCampbell, Secretary and Executive Officer." Copies may be procured from the Ohio State Board of Health at Columbus, Ohio. The report is a very complete account of the hydrology of the March flood of 1913 and of the effect of that flood upon the very great number of cities in the State of Ohio. It is illustrated with some views of flood damage and maps of practically every large community and watershed affected by the flood. Altogether it makes a most valuable reference for those interested in hydrology.

A Bridge Pier Collapsed at Lafayette, Ind., on June 26, as the result of undermining by the floods of last spring, but as the bridge was supported on falsework no damage was done and the steel superstructure was not affected. The pier was one of those of the bridge carrying the Cleveland, Cincinnati, Chicago & St. Louis R.R. over the Wabash River. The old stone pier had been lengthened some years ago to carry a double-track superstructure and the new concrete addition was carried down about 5 ft. below the old portion. Both parts were supported on piles. The flood eroded the bed of the river so as to leave the stone and concrete sections of the pier 13 and 8 ft., respectively, above the new bottom of the river, and the old portion was left almost unsupported as some of the piles were washed out. It was this portion which fell on June 26. Falsework had been built promptly after the flood, and the fall of the old pier did not affect the safety of the structure.

Forest Tent Caterpillars on the rails obstructed trains on the Long Island Railroad in June. A section of track a mile and a quarter in length through a forest was so invaded by the crawling caterpillars that their crushed bodies lubricated the rails and interfered with the action of the locomotive driving wheels. The caterpillars on the track were finally killed by spray pumps delivering a solution of nicotine and "sulphocide" and further invasion of the tracks was prevented by digging a shallow ditch on either side, which was filled with water with a film of crude oil on the surface.

The New York Sewer Plan Commission is the adopted name of a commission of engineers in the city's employ created by the Board of Estimate of New York City on June 26 to develop a plan for main drainage, sewerage and sewage disposal for Greater New York. The resolution creating the new commission requests the Metropolitan Sewerage Commission, which has been in existence for some years, to confer with the new commission "when preparing their final report." The old commission, after much study, has already put out tentative plans for sewage collection and disposal for the various sections of the city. A member of the old commission informs us, in effect, that the new commission was created at its suggestion, to promote coöperation between the old commission and the various borough governments. The language of the resolution suggests that the new commission is expected to take the leadership, as may be seen from the resolution itself, which follows:

Whereas, sewer conditions affecting each borough are and have been such as to require very serious consideration, especially as they relate to the pollution of New York Harbor. Various investigations, experiments and studies have been authorized and undertaken in the various boroughs in conformity with a general plan agreed upon between the engineers of the various boroughs looking toward the adoption of a uniform policy in all matters of sewage collection and disposal throughout the Greater City, it is important that the Board of Estimate and Apportionment, in passing upon questions affecting the future construction of sewers and sewage disposal plants, should act upon a uniform policy. The Metropolitan Sewerage Commission has been collecting data in making preliminary reports seriously affecting the work of the various boroughs; but its work is drawing to a close, and it is required by law to submit a final report to the Board of Estimate and Apportionment and to turn over to them all data collected. It would seem desirable that there should be some coördination of the work of the Metropolitan Sewerage

Commission, and of the Sewer Bureaus of the Borough Presidents. Therefore be it

Resolved, that the Consulting Engineers of the boroughs with the Chief Engineer of this Board be constituted a commission for the development of a plan of main drainage, sewage collection and disposal that will meet the future needs of the entire city; and be it further

Resolved, that the Metropolitan Sewerage Commission is hereby requested to confer with the said Commission of Engineers when preparing their final report.

The members of the Commission are as follows: Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment; Ernest P. Goodrich, Consulting Engineer of the Borough of Manhattan; Geo. W. Tillson, Consulting Engineer of the Borough of Brooklyn; Amos L. Schaeffer, Consulting Engineer of the Borough of The Bronx; Foster Crowell, Consulting Engineer of the Borough of Queens; Louis L. Tribus, Consulting Engineer of the Borough of Richmond.

The Commission organized by electing Nelson P. Lewis, Chief Engineer of the Board of Estimate and Apportionment as Chairman, and Charles E. Gregory, Deputy Consulting Engineer of Manhattan, as Executive Secretary. It was resolved that the official name of the Commission should be "The New York Sewer Plan Commission."

PERSONALS

Mr. W. H. Scribner has been appointed Supervisor of mechanical examinations of the Lake Shore & Michigan Southern Ry., at Cleveland, Ohio.

Mr. Henry P. Webb has opened an office at 50 Church St., New York City, as a specialist in structural steel and factory extension.

Mr. G. H. Dryden, recently Assistant Signal Engineer of the Baltimore & Ohio R.R., Baltimore, Md., has promoted to be Principal Assistant Signal Engineer.

Mr. J. Edgar Borden, recently Assistant City Engineer of Fall River, Mass., has been appointed City Engineer, succeeding Mr. Philip D. Borden, resigned, as noted below.

Mr. Philip D. Borden, for the past 31 years City Engineer of Fall River, Mass., has resigned. Mr. Borden has been connected with the city engineering department for over 40 years.

Mr. W. R. Trowbridge, formerly Assistant Supervisor of the New York division of the Pennsylvania R.R., has been promoted to be Supervisor of the Trenton division, at Trenton, N. J.

Mr. James H. Sturtevant, Assoc. M. Am. Soc. C. E., recently Acting Deputy Commissioner, New York State Department of Highways, has been appointed Division Engineer, which is the position he formerly occupied.

Mr. T. G. Smith, recently Division Engineer of the Missouri, Kansas & Texas Ry., at Smithville, Tex., has been appointed Superintendent of the Houston & Brazos Valley R.R., with headquarters at Freeport, Tex.

Mr. James A. Newlands has resigned as Chemist of the Connecticut State Board of Health to become associated with the Henry Souther Engineering Co., Engineers, Metallurgists and Analysts, 11 Laurel St. Hartford, Conn.

Mr. F. O. Dufour, Assoc. M. Am. Soc. C. E., has resigned as Assistant Professor of structural engineering, University of Illinois, to accept the position of Construction Engineer with Mr. D. A. Keefe, Consulting Engineer, Athens, Penn.

Mr. William E. Leffingwell, a hotel proprietor, of Watkins, N. Y., has been appointed by Governor Sulzer a member of the Public Service Commission of New York, Second District, at a salary of $15,000 per annum.

Mr. Charles J. Chase, of Croton-on-Hudson, N. Y., a locomotive engineman on the New York Central & Hudson River R.R., has been appointed by Governor Sulzer a member of the Public Service Commission of New York, Second District, at a salary of $15,000 per annum.

Mr. Charles W. McMeekin, Assoc. M. Am. Soc. C. E., General Manager of the Croesus Gold Mining & Milling Co., Plumbago, Sierra County, Calif., has opened an office in Nevada City, Calif., for general practice as a consulting engineer.

Mr. J. F. Rodgers, formerly Field Engineer in charge of track and roadway of the Board of Supervising Engineers of the Chicago Traction, has been appointed Superintendent of Track of the Chicago City Ry., succeeding Mr. W. F. Graves, resigned.

Mr. Herbert Johnson, recently with the engineering department of the Chicago, Milwaukee & St. Paul Ry., has been appointed Engineer of the sewer division of the city engineering department of Kansas City, Mo. The appointment is for 60 days, pending the holding of a civil service examination.

Mr. A. S. Bland, formerly Assistant Division Engineer of the Pennsylvania R.R. lines west of Pittsburgh, at Chicago, Ill., has been promoted to be Division Engineer of the Peoria division of the Vandalia R.R., at Decatur, Ill., succeeding Mr. H. C. Johnson, transferred to the Michigan division at Logansport, Ind.

Mr. J. W. Orrock, M. Can. Soc. C. E., recently Division Engineer of the Canadian Pacific Ry. at North Bay, Ont., has been promoted to be Principal Assistant Engineer, with headquarters at Montreal, Que., succeeding Mr. Collingwood B. Brown, Jr., Assoc. M. Can. Soc. C. E., resigned, as noted in our issue of last week.

Mr. R. Q. Prendergast, formerly Master Mechanic of the Cincinnati, Hamilton & Dayton Ry., at Indianapolis, Ind., has been appointed Mechanical Superintendent of the Bangor & Aroostook R. R., with headquarters at Milo Junction, Maine, succeeding Mr. H. Montgomeery, Superintendent of Motive Power and Equipment, resigned.

Mr. Edwin F. Wendt, M. Am. Soc. C. E., a member of the Board of Valuation Engineers of the Interstate Commerce Commission, and President of the American Railway Engineering Association, was awarded the honorary degree of Doctor of Science, at the recent commencement of Geneva College, Pennsylvania. Mr. Wendt graduated there in 1888.

Mr. Fred Lavis, M. Am. Soc. C. E., who has been in Buenos Aires, Argentine Republic, for several months, on his work as Chief Engineer of Argentine Ry. Co., has returned to this country. Mr. Lavis is a member of the firm of Guerber & Lavis, Consulting Engineers, with offices at 50 Church St., New York City.

Mr. B. L. Winchell has resigned as Receiver of the St. Louis & San Francisco R.R. to become Director of Traffic of the Union Pacific Ry., with headquarters at Chicago, Ill. Until the recent failure of the St. Louis & San Francisco R.R. he was President of the company. From 1904 to 1909 he was President of the Chicago, Rock Island & Pacific Ry.

Messrs. W. C. Nixon and W. B. Biddle, of St. Louis, Mo., have been appointed Receivers of the St. Louis & San Francisco R.R., succeeding Mr. B. L. Winchell, resigned, as noted elsewhere. Mr. Nixon was formerly Vice-President in charge of maintenance and operation and Mr. Biddle was Vice-President in charge of traffic. They will continue to have charge of these departments, respectively.

Mr. C. S. Mellen, President of the New York, New Haven & Hartford R.R. has resigned the presidency of two of the New Haven's subsidiaries, the Boston & Maine R.R. and the Maine Central R.R., and will devote his whole time to his duties as the chief executive of the New Haven. He is succeeded as President of the subsidiary lines mentioned by Mr. Morris McDonald, as noted elsewhere.

Mr. Frederick J. Macleod, former Chairman of the Massachusetts Board of Railroad Commissioners, has been made Chairman of the new Public Service Commission, which includes the other two members of the former Railroad Commission, Messrs. Clinton White, of Boston, and George W. Bishop, of Newtonville. The two new members of the Public Service Commission are Messrs. George H. Anderson, of Boston, and George P. Lawrence of North Adams. The salary of the chairman is $8500 per annum and of the other members $8000.

Dr. C.-E. A. Winslow, Associate Professor of biology at the College of the City of New York and Curator of public health of the American Museum of Natural History, has been appointed Chairman of a commission on the experimental study of ventilation problems, with an appropriation of $50,000, which is a part of the gift of Mrs. Elizabeth Milbank Anderson to the Association for Improving the Condition of the Poor. Prof. E. B. Phelps, of the department of biology of the Massachusetts Institute of Technology, is also a member of the commission.

Mr. Edward N. Lake, F. Am. Inst. E. E., Electrical Engineer of the Stone & Webster Engineering Corporation, Boston, Mass., has been appointed Chicago representative of the corporation. Mr. Lake was formerly located in Chicago, where at various times he was connected with the Western Electric Co., the Chicago Edison Co., the Arnold Co., and the Board of Supervising Engineers of the Chicago Traction. He is a member of the American Society of Civil Engineers and the Western Society of Engineers.

Mr. Morgan K. Barnum, whose resignation as General Superintendent of Motive Power of the Illinois Central R.R. was

noted in our issue of May 29, has been appointed Inspector of Machinery and Equipment of the Baltimore & Ohio R.R., and the Cincinnati, Hamilton & Dayton Ry. Mr. Barnum will be a member of the staff of Vice-President A. W. Thompson, and will devote his time to the establishment of standards, methods and practices in connection with machinery and equipment. Mr. Barnum is a graduate of Syracuse University, class of 1884, and began railway work that year as a special apprentice in the shops of the New York, Lake Erie & Western R. R. at Susquehanna, Penn. He has serveed in various capacities in the mechanical departments of the Louisville & Nashville R.R., the Atchison, Topeka & Santa Fé Ry., the Union Pacific R.R., the Southern Ry., the Chicago, Rock Island & Pacific Ry., the Chicago, Burlington & Quincy R.R. and the Illinois Central and Yazoo & Mississippi Valley R.R.

Mr. R. N. Begien, Assoc. M. Am. Soc. C. E., recently Assistant General Superintendent of the Baltimore & Ohio R.R., at Baltimore, Md., has been promoted to be General Superintendent of the Baltimore & Ohio Southwestern R.R., exclusive of the Cincinnati Terminal division, with headquarters at Cincinnati, Ohio. Mr. Begien is a native of Boston, Mass., and a graduate of Harvard University, class of 1897. With the exception of four years, three and a half with the Nicaragua Canal Commission and the remainder with the Guayaquil & Quito R.R. in Ecuador, he has been continuously in the service of the Baltimore & Ohio R.R. since completing his college course. In 1902 he was appointed Assistant Engineer of the Baltimore & Ohio R.R., at Somerset, Penn. He was promoted successively to be Division Engineer at Philadelphia, Penn., in 1908; Acting Engineer of Maintenance-of-way in 1909, Assistant to the Chief Engineer in 1910, Assistant to the General Manager in 1911, Assistant to the Third Vice-president and Assistant General Superintendent in 1912.

Mr. Morris McDonald, formerly Vice-President and General Manager of the Maine Central R.R., at Portland, Maine, has been elected President of the Boston & Maine R.R. and the Maine Central R.R., succeeding Mr. C. S. Mellen, resigned as noted elsewhere. Mr. McDonald entered the railway service in 1883 with the engineering staff of the Kentucky & Indiana Bridge Co., but left engineering work in 1885 to become paymaster of the Evansville & Louisville R.R. In seven years he had passed through the grades of Assistant Treasurer, Chief Clerk to Superintendent, Trainmaster and Superintendent of Transportation. For the year 1893 he was Chief Clerk to the Superintendent and Assistant Trainmaster of the Savannah division of the Central of Georgia R.R. Mr. McDonald was first employed on the Maine Central R.R. in 1896 as Secretary to the General Manager. In 1897 he was promoted to be General Superintendent and in 1908 was made Vice-President and General Manager. He is succeeded as General Manager by Mr. George S. Hobbs, former Second-Vice-President and Comptroller.

Mr. J. B. Lippincott, M. Am. Soc. C. E., Assistant Chief Engineer of the Los Angeles Aqueduct, has opened offices in the Central Bldg., Los Angeles, Calif., for the general practice of civil engineering. Mr. Lippincott is a native of Scranton, Penn., and a graduate of the University of Kansas, class of 1886. His engineering work began the same year with the Atchison, Topeka & Santa Fé Ry. For four years 1888-1892 he was a topographer in the United States Geological Survey. Following this work he was Assistant Engineer of the Bear Valley Irrigation Co., in California. Shortly afterward, in 1893, he returned to the service of the United States Geological Survey as Hydrographer for California, and he remained in this office until 1902, when he was made Supervising Engineer, United States Reclamation Service, in charge of the Pacific Coast district. Mr. Lippincott resigned from the Reclamation Service in 1906 to accept the position of Assistant Chief Engineer of the Los Angeles Aqueduct, which has now been practically completed. Besides this work he has been for several years Consulting Engineer on water supplies for San Francisco, Los Angeles, Fresno, Santa Barbara and other California cities. Associated with Mr. Lippincott will be Mr. Edward R. Bowen, Assoc. M. Am. Soc. C. E., whose specialty is steel and concrete construction.

OBITUARY

Jacob Hudson Wise, a civil engineer engaged in Cuban enterprises was killed by a train at Rahway, N. J., July 7.

John D. Rippel, a civil engineer of Sunbury, Penn., employed on the construction of the Ebro Irrigation & Power Co. Ltd., dam and hydroelectric power plant in Spain, was drowned at Lerida, May 27.

Henry Burton, a young American engineer employed in the testing laboratories of the Mexican Northern Power Co., at Santa Rosalia, Chihuahua, Mex., was shot and killed on July 6 by a drunken Mexican soldier. Mr. Burton was 22 years old and his home was in Upper Montclair, N. J.

Frederick W. Gordon, Sr., a mechanical engineer and metallurgist of Philadelphia, Penn., died at his home in that city July 11, aged 71 years. Mr. Gordon was a member of the firm of Gordon, Gobel & La Rue, which was later merged with the Niles-Bement-Pond Co., of which company Mr. Gordon was a director at the time of his death.

James C. Haugh, M. Am. Soc. C. E., Resident Engineer of the New Orleans & Northeastern R.R., was killed in New Orleans, La., on July 6, by an automobile. He superintended the construction of the 28-mile trestle across Lake Pontchartrain in 1884. Mr. Haugh was formerly in the city engineering department of Cincinnati, Ohio. He was 58 years old and a native of New York City.

Dr. Benjamin Lee, Assistant Commissioner of Health of Pennsylvania and formerly Chief Health Officer of the Port of Philadelphia, died at his home at Point Pleasant, N. J., July 12, aged 80 years. He was born in Norwich, Conn., and graduated from the University of Pennsylvania. He was a surgeon in the Union Army during the Civil War. In 1885 he was appointed a member of the then newly created Pennsylvania State Board of Health, of which he was Secretary for 20 years. Dr. Lee rendered valuable service in times of epidemic and flood disasters, particularly at the time of the Johnstown flood of 1889.

ENGINEERING SOCIETIES

COMING MEETINGS

OHIO ELECTRIC LIGHT ASSOCIATION.
July 15-18. Annual convention at Cedar Point, Ohio. Secy., D. L. Gaskill, Greenville, Ohio.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
July 17-19. Annual summer meeting at Buffalo, N. Y. Secy., E. A. Scott, 29 W. 39th St., New York City.

INTERNATIONAL GEOLOGICAL CONGRESS.
Aug. 7-14. Twelfth annual session at Toronto, Ont. General Secy., R. W. Brock, Director of Geological Survey of Canada, Ottawa, Ont.

THE TRAVELING ENGINEERS' ASSOCIATION.
Aug. 12-16. Annual convention at Chicago, Ill. Secy., W. O. Thompson, New York Central Car Shops, East Buffalo, N. Y.

INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS.
Sept. 1-6. Annual convention at New York City. Secy., Jas. McFall, Roanoke, Va.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 10-12. Annual convention at Philadelphia, Penn. Secy., Willard Kent, Narragansett Pier, R. I.

AMERICAN PUBLIC HEALTH ASSOCIATION.
Sept. 9-13. Annual meeting at Colorado Springs, Colo. Secy., S. M. Guma, 755 Boyleston St., Boston.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.
Sept. 9-12. Annual convention at Ottawa, Ont. Secy., A. P. Dane, Reading, Mass.

The American Mining Congress—The 16th annual convention will be held in Philadelhia, Penn., Oct. 20-25.

The International Electrical Congress—Preliminary plans for the congress to be held in San Francisco, during the week beginning Sept. 13, 1915, in conjunction with the Panama-Pacific International Exposition, and under the auspices of the American Institute of Electrical Engineers, are being effected by the committee on organization. In the week preceding the congress there will be a meeting of the International Electrotechnical Commission. The congress is being divided into 12 sections as follows: (1) Generation, Transmission and Distribution; (2) Apparatus Design; (3) Electric Traction and Transportation; (4) Electric Power for Industrial and Domestic Use; (5) Lighting and Illumination; (6) Protective Devices and Transients; (7) Electrochemistry and Electrometallurgy; (8) Telegraphy and Telephony; (9) Electrical Instruments and Electrical Measurements; (10) Economics of Central Stations and Systems; (11) Electro-Physics; (12) Miscellaneous. In each section it is desired to include many notable papers dealing with the status or the progress of the art. Offers of papers and suggestions in this connection should be directed to the Secretary of the Committee on Organization, Dr. E. B. Rosa, Bureau of Standards, Washington, D. C.

ENGINEERING LITERATURE

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CORRESPONDENCE

Comments on the Review of "Rational and Applied Mechanics"

Sir—Permit me to make brief comment on the grounds recently taken by Prof. H. T. Eddy in regard to the propriety of regarding applied mechanics as a strictly professional branch of study, and as to its position in the curriculum, as set forth in his short but complimentary judgment of my recently published book, "Rational and Applied Mechanics" [see "Eng. News," Apr. 17, 1913]. Also permit me to remark that his arguments against what he assumed to be my position in regard to the college curriculum has nothing to do with the merits or demerits of my textbook.

I cheerfully recognize Dr. Eddy's high scholarship and keen insight into the whole range of theoretical and applied mechanics. Accordingly I am well pleased when he pronounces my book "an excellent one, well arranged and well written," and more to the like effect.

Now as to the program and the curriculum: Prof. Eddy and I agree that the student in mechanics must have mathematics enough to be able to follow and comprehend the analyses and demonstrations as he reads the book. We both insist upon the free use of the calculus as occasions arise. The calculus is taught to be used, and it is good for nothing unless used.

An excuse (if an excuse is wanted) for discussing the curriculum in connection with a review of a textbook is found in my remarks in the Preface that "the book is written primarily for students entering upon their second college year"; and that "a class not ready to use the calculus should for a while skip" certain chapters. Here is where Prof. Eddy and I differ. He would defer analytical and applied mechanics till the third or junior year, when the course in mathematics will have been completed. I favor mechanics as a sophomore and junior study, and I would let calculus and mechanics overlap. Prof. Eddy vigorously defends his position. I am prepared to strenuously defend mine. He thinks two such difficult studies as mathematics and mechanics would overburden a student, and weaken his grasp on both of them. I think that if properly taught the calculus and mechanics are mutually helpful. Mechanics justifies and utilizes the calculus, and the simultaneous study of continuous functions, continuous materials, and continuous motions is extremely beneficial. I speak from abundant experience as a teacher of both subjects, and I know how one subject throws light upon the other.

But I protest that this discussion has nothing to do with my textbook. I wrote it for students of all grades, and it has been used in different grades. Prof. Clarence A. Waldo, of Washington University, found the book "exceptional in the interest it aroused" in his sophomores who were studying the integral calculus at the same time. "It early sweeps away the usual difficulties which beset the student and make the beginnings" of mechanics difficult, he says.

Prof. Robert Fletcher, Dean of the Chandler Engineering School, took his seniors practically through the book, and their verdict is also "very satisfactory."

Of course, the seniors found the book easy; but the sophomores mastered it without difficulty, and it would have been a misfortune had the mechanics been delayed.

Finally, Prof. Eddy says that "applied mechanics seems to be a professional subject"; and he appears to approve restricting it to classes of professional students. He says most of the standard textbooks on mechanics today are written from that standpoint. He admits that the standpoint may be wrong, but he subscribes to it, and he criticises my book because it is "rational" and not exclusively professional.

I admit that it is rational, all the way through, though it freely draws problems from all departments of applied science. I do not favor the strictly professional standpoint. The scope of mechanics is too broad for a single professional course. The laws of force and motion, of strength and stability, are universal, and every trained man of affairs, technical or otherwise, should be familiar with those laws, and he should see that they are rational.

It is obvious that Prof. Eddy's interesting discussion of program and curriculum should have been printed under a separate caption.

CALVIN M. WOODWARD.

3013 Hawthorne Boulevard, St. Louis, Mo., June 5, 1913.

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"The Practical Railway Spiral" and the Metric System

Sir—On May 15 you published a review of my little book, "The Practical Railway Spiral," in which it was intimated that this spiral is not applicable to use in the metric system. This opinion probably resulted from failure to notice the last statements on page 42.

Thinking that some of your readers would be interested in an easy method of figuring metric curves, I inclose full transit notes for a 4° curve with 45-meter spirals.

Since metric curves are laid out with a 20-meter tape, one unit of measure is employed where we use five. Consequently, if all dimensions of a curve are computed according to our own methods and then these dimensions are divided by five, the result will be a metric curve of the same nominal degree.

In the accompanying notes the tangent distance was computed by the formula

$$T = d + (R + P) \tan \tfrac{1}{2} A$$

and the 4° curve with the 225-ft. spiral was used. The table gives d = 120.80 and log (R + P) = 3.156,479. And T is found to be 649.27. Finally, dividing by five, T = 129.85. Other values are readily seen from the notes. This curve is approximately as sharp as a 6° curve, as run according to methods in the United States.

Stations	Alignments	Deflection Angles	Back Sight Angles	Functions	Courses
				M.C.=N5°00'W	
569+28.01	P.T.			C.C.=N55°W	
+25.01			0°00½'		
+40.01			0°04'		
+35.5			0°13'	I=4°10"	
+28.01			0°27½'	L=45	
+20.5			0°40'		
569+13.01	P.C.S.	16°04'	1°14½'		
569		14°46'			
+80		12°46'		A=40°26'	
+60		10°46'		A-I=36°16'	
+40		8°46'		L=160.67	
+20		6°46'		P.I.=568+37.19	
568		4°46'		T=129.85	
+80		2°46'			
+60		0°46'			
567+52.34	P.S.C.	1°14½'	2°55½'		
+46.84		0°13'		I=4°10'	
+37.34		0°27½'		L=45	
+29.84		0°13'			
+22.34		0°04'		D=4°	Left
+14.84		0°00½'			
567+07.34	P.S.			M.C.=N11°20'W	
				C.C.=N65°13'W	

Eng. News

AN EASY METHOD OF FIGURING METRIC CURVES

The table gives d = 120.80 and log (R + P) = 3.156,479. And T is found to be 649.27. Finally, dividing by five, T = 129.85. Other values are readily seen from the notes. This curve is approximately as sharp as a 6° curve, as run according to methods in the United States.

LEONARD C. JORDAN.

243 Ryerson St., Brooklyn, N. Y., June 9, 1913.

REVIEWS AND NOTES

Chemical Analysis of Gas

Reviewed by G. A. BURRELL*

GAS ANALYSIS—By L. M. Dennis, Professor of Inorganic Chemistry, Cornell University. New York: The Macmillan Co. Cloth; 5x8 in.; pp. xvi + 434; 110 text illustrations. $2.10, net.

In general plan this book follows the last edition of the English translation of Hempel's "Methods of gas analysis" by Dennis. New material has been added, and some of the older methods eliminated or modified. The older book is so well known to gas analysts and others that an attempt is only made here to draw attention to some of the more important changes that occur in the new book.

Winkler's metal tube for sampling furnace gases is described, as is also Huntley's pipette for collecting an average sample of gas over a considerable period of time. The Töpler pump is also described, and a scheme used by Travers for collecting the gases set free when minerals are heated in sealed tubes with sulphuric acid. A short chapter has been added having to do with the measurement of large samples of gas. Three different schemes are described. Details of tests showing the degree of accuracy to be obtained with an instrument called the rotameter would have been desirable. Bolander's instrument for calculating the weight of gas in a measuring burette from its volume is described.

Dennis has arranged a handy carrying case so that the Hempel technical apparatus, gas analysis over water, can be conveniently carried about. Four forms of pipettes are also described in which the liquid and gas are brought in intimate contact, and which are especially designed (three of them developed from Hankins' original form) for oxygen and carbon-monoxide determinations. There appears to be scarcely enough difference in efficiency of these different forms to warrant usage of the more costly forms. Dennis also describes a modified Orsat aparatus which is equipped with three bubbling pipettes of his own design. The reviewer doubts the advisability of complicating the ordinary Orsat apparatus with these complex pipettes for flue-gas analysis, considering the fact that the Orsat is much used by men little skilled in gas analysis. The short saving in time of analysis accomplished by using these forms of pipette seems of little advantage, since the ordinary simple Orsat when rightly used gives good results on flue gas as regards CO_2, O_2 and CO determinations, remembering, of course, that flue gas usually contains but small quantities of CO.

A short chapter on glass-blowing and apparatus construction has been added.

The chapter on the purification of mercury would have been made more valuable by the inclusion of Hulett's scheme for preparing pure mercury by distillation.

Regarding the explosive limits of different gases given (p. 144) the reviewer believes that these values of Teclu's are in error as regards methane, acetylene, and illuminating gas, when an electric spark is used as the source of ignition. Experiments by the reviewer and others have shown this.

The portion of the book which deals with the detection and determination of ozone has been considerably revised and the different methods discussed. A method found satisfactory by Keiser and McMaster has been included, by means of which ozone can be detected in the presence of nitrogen peroxide and hydrogen peroxide. Treadwell and Anneler's method for the determination of ozone in atmospheric air is also described.

The Simmance Abady and antolysator carbon-dioxide recorders are described. Brief mention is made of the gas refractometer.

For the determination of heating values of coal and gas, Mahler's bomb and Junker's calorimeter are again described, and methods of Hempel which are not used in this country, at least, have been omitted. Anderson's modification of the Petterson Palmquist apparatus for CO_2 determinations is described.

In summing up the reviewer would say that this excellent book has kept pace with advances in rapid methods of technical gas analysis. Methods described in the previous edition which are little used or obsolete have been dropped and new material added. For the student, and for the technical gas analyst especially, the book is even better adapted than its predecessor, and much may be found for the worker in exact gas analysis.

It is believed, however, that some attention should have been paid to natural-gas analysis. This subject and that of mine-air analyses are not specifically touched upon. In both of these branches there is need of direction. Very few published analyses of natural gases are correct, and mine-air analysis represents a branch of the general subject that demands exceedingly precise work. Another omission appears to be the leaving out of the highly useful and simple form of the ordinary Orsat apparatus, not encumbered with complicated pipettes. There also are some assembled forms of technical gas analysis apparatus for rapid work on the market that should have been given some attention. The Haldane gas analysis apparatus for instance is a machine that the reviewer believes has many superior points for some exact gas work. There are also some apparatus in use at steel works and other places that merit attention in a book that is especially meant to cover the general subject of rapid methods of technical gas analyses.

*Chemist, Gas Investigations, U. S. Bureau of Mines, Experiment Station, Pittsburgh, Penn.

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The Failure of Democracy

THE PRICE OF INEFFICIENCY—By Frank Koester, A. M. Am. Inst. E. E., author of "Hydro-electric Developments and Engineering," "Steam Electric Power Plants," "Electricity for the Farm and Home," "American City Planning," etc. New York: Sturgis & Walton. Cloth; 6x9 in.; pp. xxiv + 439. $2, net.

A scathing condemnation of American institutions is made by the author of this book. He openly charges the United States government with destroying prosperity, creating lawlessness and turmoil, crippling business enterprises and with every form of incompetency, extravagance and graft. He charges it with failing to advance the cause of education, to protect small industries, to prevent concentration of wealth. He says the people have lost confidence in the constitution, in the courts and in the executives and are clamoring for a form of government which is more efficient. According to him, the United States is a seething cauldron of iniquity and rebellion, whose stench goes up to Heaven. Here the poor are becoming poorer, the rich richer and more oppressive, the monopolies more malignant, the common rights of the individual less respected. Government of the people, by the people and for the people is therefore a failure.

Admitting that many of the author's charges have some foundation in fact, admitting that we have wasted some natural resources and failed to utilize others, that science and invention have languished, that politics has been too often a dirty game, that failure to limit immigration has led to evidences of growing local disorder, admitting all these, it is yet to be proved that the author's picture represents things as they really are. The author has diligently read the daily newspaper stories of crime and sin and corruptions; but this is not a true picture of the daily life of ninety millions of people. It is on this picture, however, that the author relies as an argument for remodeling all our institutions on the pattern of the German Empire. That is the only governmental scheme the author can see virtue in, for after each recital of American evils he reverts to his "now in Germany."

An idea of the colored spectacles through which the author views all things American, we quote the following brief extracts:

> Only accidentally does a great man become President of the United States. . . . . Too often the President is the resultant of bosses of which he is not one, a person crafty enough to float with the tide and conventional enough to be in harmony with the intensely conventional views of the electorate. (Page 12.)
>
> The states are now merely political divisions and the American is a citizen of the United States and has very little more patriotism for his particular state as such than he has for his backyard, and takes much less interest in it than he does in the baseball club representing his city. The organization of the state governments continues, however, with considerable vigor, though constantly being deprived of powers by the Federal government through Supreme Court decisions. (Page 18.)
>
> No President desires to go down to posterity as an apostle of economy. Even great financiers prefer to be known by large dealings rather than close acquiring. (Page 22.)
>
> No citizen has any right to receive a letter or to have a letter delivered when mailed to him except at the pleasure of the department. The courts have decided that use of the mails is a privilege which is not a right. . . . . A department thus which possesses so much power may be depended on to exercise it to the disadvantage of the public. . . . . The service rendered in the dispatch and delivery of mails is inferior to that in the principal European countries. (Page 27.)
>
> The Constitution is not a means whereby the will of the people can be expressed. Indeed, it continually circumvents the will of the people and offers no means whereby the will of the people can be expressed definitely on any given subject. . . . . There is a well grounded suspicion that the framers of the Constitution were influenced by motives which are now ascribed to the "interests." The Constitution as it exists is an instrument under which the pursuit of wealth may be carried on to the greatest possible advantage (page 153). The Constitution is defective, antiquated and unsuited to the purposes of liberty. It is bound to go. (Page 159.)
>
> In most constitutional monarchies and in other republics the cabinet expresses at all times the will of the people and is usually composed of the most eminent men, not the second-raters that get into American cabinets. (Page 153.)
>
> The system of the selection of the candidates for president is such that the strongest men of the country having by

their strength aroused animosities and jealousies, are unable to secure the nomination and compromise men are selected, chiefly distinguished for not being objectionable to any faction. A sort of harmless type of person, therefore, has the best chance of becoming an American president, and it is a fact that the Presidents of the United States have been during its history by no means leading men. This is a fault of the constitutional system which is held in such absurd venera- . . . (Page 182.)

The relations between capital and labor in America and the relations to the public amount to a system of exploitation and spoliation at every turn which is undermining the foundations of prosperity and industry. . . . The workman is destined more and more to remain a workman and as such his former ambition to be a good workman in the hope of advancement has been abandoned. He is now out to get all he can right away and do as little work for it as possible. . . . . (page 182).

Americans as individuals are largely standardized. They wear a standard hat, a standard coat and standard shoes. The same necktie rules from Maine to California and the umbrella in Chicago is a twin of the umbrella in New Orleans and likely out of the same factory. The standardization extends even to the fiber of the individual and what he does and is and thinks even. The cheapness of the standard products causes their use by every one so that in every American home much the same furniture will be found as in any other. The carpets, rugs and pictures will be the same, or very nearly so. Thus a machine-made atmosphere, a lack of originality and personality and the lack of the opportunity for developing taste envelops the American, and still further makes of him a standardized unit to live a standardized life and be buried in a standardized coffin by a standardized undertaker who furnishes a standardized funeral for $75.

The above extracts are typical of the whole book and certainly sufficiently illustrate the author's state of mind.

We have no doubt at all as to the excellence of German institutions and of the great benefit to be gained from intelligent study of these institutions by Americans. To suppose, however, that all our serious problems, social, financial industrial and governmental, can all find instant happy solutions by throwing overboard all our institutions and establishing in their place those of any other nation, even one so well administered as Germany, is an absurdity on its face.

Without some modicum of the judicial temperament no author can hope to make a valuable contribution to the literature on the topics with which this book is concerned.

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Dynamo Laboratory Experiments

DYNAMO LABORATORY OUTLINES FOR STUDENTS IN ELECTRICAL ENGINEERING—By John Fay Wilson, Department of Electrical Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. ix + 129; 84 text illustrations. $1, net.

The author announces that he is not an advocate of that type of science teaching which tells a student how to proceed and what to expect, leaving him only the task of verification. He also shows some fear that he is not in accord with the latest contrasting idea for he cannot accept a scheme which turns the student loose in the field to discover, by his own intiative and experience, laws we would have him learn.

But, as we understand the recent trend of this branch of pedagogy, the author need have no such fears. It is only the "forked-road" situation which such a theorist tries to create. By such a plan, the student is directed to make certain experiments, but is not told just what will happen or just what the observed facts teach. This accumulation of evidence and its scrutiny tends to give him a widely applicable ability to observe, deduce and generalize, so essential for an engineer, even though it does not do so much toward fixing the formal statement of a law in the student's mind as is desired by the "orthodox" teacher. Engineering-laboratory work, we should note here, also has a further utility in giving some slight inkling into the character and procedure of practical research. From both the pedagogical and utilitarian viewpoints, this text is for the most part satisfactory.

The author makes the unusual proposition that an abbreviated manual of 130 small pages on some 21 general topics, can give the substance of every experiment of general interest with dynamo machinery. The experiments noted are on (1) structural examination, (2) characteristic performance of direct-current generators, (3) conditions affecting generation of potentials, (4) parallel operation of direct-current generators, (5) characteristic performance of direct-current motors, (6) torque and speed effects, (7) stray losses, (8) magnetic phenomena in direct-current machinery, (9) boosters, (10) heating tests, (11) insulation resistance, (12) properties of alternating-current circuits, (13) characteristic performances of alternating-current generators, (14) parallel operation of alternators, (15) synchronous motors, (16) rotary converters, (17) induction motors, (18) commutating alternating-current motors, (19) performance of static transformers, (20) transformer iron losses, (21) rectifiers. The text has 39 formal divisions and naturally some further subdivisions, but the foregoing limited generalization covers the contents.

Can the embryo electrical engineer acquire by such an abbreviated course all the several needed elements of training which he could transfer and variously recombine so as to be able to work up any machine test he might be called on to make? Theoretically, if all the elements are here it would seem as though such a scheme were feasible. If experience shows the soundness of this supposition, most teachers of electrical engineering will be glad to reduce the amount of laboratory work. We believe, however, that most of these teachers will feel that such abbreviated training might have to do for short-course students like mechanical-engineering men, but that more experience in the laboratory is desirable so that the actual recombination of the several bits of elementary knowledge and experience should be made by experiments beyond the scope of this manual.

Evidently the author also holds that much of the work planned in some more complete manuals, like Karapetoff's guide, belongs to the physical laboratory; yet there is much to be said for the gain in repeating some of the work there done under the atmosphere of pure science, to the commonplace industrial machinery that we have in the strictly engineering laboratory. Also there is a great deal of work that is necessary in connection with such a course, not touched on here at all—such as the calibration of commercial indicating and recording instruments.

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Efficiency in College Teaching

A SYMPOSIUM ON SCIENTIFIC MANAGEMENT AND EFFICIENCY IN COLLEGE ADMINISTRATION, Comprising Among Others the Papers Presented at the Efficiency Session of the Twentieth Annual Convention of the Society for the Promotion of Engineering Education. Ithaca, N. Y.; Prof. H. H. Norris (Cornell University). Cloth; 6x9 in.; illustrated. $1, net.

The several papers making up this "symposium" comprise a list presented at a recent annual convention of the Society for the Promotion of Engineering Education in Boston, June, 1912.

After an introduction by the secretary of the society, Prof. H. B. Norris, F. B. Gilbreth compliments those "busy men" (including himself) who so freely gave of their time to instruct the instructors. Harrington Emerson paints some pretty allegories turning from the past to the future. F. A. Parkhurst describes some of the Taylor aims—"scientific attack, harmony, coöperation, maximum output, development of personal efficiency and prosperity." Meyer Bloomfield likens his hobby (economic vocational guidance) to "efficiency engineering." H. L. Gant boosts the engineer as a manager and calls the efficiency movement "management engineering." H. K. Hathaway outlines the qualities that make for success in scientific management (which incidently are the same old virtues which insure success anywhere). So far the reader has covered a quarter of the book and never a thought about the improvement of the colleges.

Wilfred Lewis, following, comes a trifle closer when he says the colleges should collect data on "scientific management" and work with efficiency engineers to scrutinize college methods, looking on the college as a factory and the grads as the product. R. T. Kent calls the shop the best auxiliary to the college in this work. R. B. Wolf asks the colleges to have courses in the philosophy and mechanism of efficiency work and to have them taught by men of experience. Hollis Godfrey pursues the same request, but becomes a little more specific.

After this the professors have an inning. Walter Rautenstrauch, first up, claims that additions to curricula will not afford the needed reformation, but by interweaving relevant studies of the science of production in all engineering courses it is secured. (At this point H. F. J. Porter interjects some very general remarks which, due to a lapse of the editor, are out of order.) Louis J. Johnson remarked that nothing helped efficiency in results or instruction like teaching the idea that engineering principles applied to the whole range of civic and industrial problems. F. P. McKibben produces some figures to show that a large percentage of absentees from classes shows inefficiency in teaching and such absence leads to inefficiency in after life. W. A. Hillebrand analyzes the time he puts into teaching and finds it 40% too heavy for properly keeping up in the advance of his profession and in building up a reputation, etc., without too much infringing on social and family life. He has arranged a desirable schedule and gives a method of synthesizing costs to arrive at a necessary annual appropriation. Dean Goss argues that school shops have been stepping stones to broader technical courses, and while directly giving knowledge of materials, have now a higher use to be made of them in industrial research. Sanford E. Thompson rises (through

another lapse of the editor?) to interject his views on the need of setting more specific tasks before students.

Hugo Deimar, after briefly noting the many activities of the department of industrial engineering at the Pennsylvania State College, claims that inefficiency in schools is seldom due to insufficient industry of the teachers, but, in great contrast to commercial life, to lack of such aids as stenographers, recording clerks, etc., private offices and studies, etc. Wm. Kent (perhaps writing as Prof. Kent) cites two parallel cases of inefficient organization—one a factory and one an engineering department of a large college, before outlining a general scheme which might be followed by an institution which would have itself studied and purged of this sin. H. Wade Hibbard, after summarizing the Taylor and the Emerson "principles," shows how they could be applied to the analysis and criticism of college work. He warns against panaceas and universal systems, but shows how the administration and instruction may be reorganized to aline with the best thought. George H. Shepard and S. E. Whitaker (not professors) go over the same ground but in a more general way. The volume ends with a few remarks by Earle F. Palmer on the gain of applying the Gibrethian functionization.

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The Calculation and Construction of Furnaces

Reviewed by BRADLEY STOUGHTON*

CHEMICAL ARITHMETIC AND CALCULATION OF FURNACE CHARGES—By Regis Chauvenet, M. Am. Inst. Min. E. Philadelphia and London: J. B. Lippincott Co. Cloth; 6x9 in.; pp. xi + 302; $4, net.

REFRACTORIES AND FURNACES: Properties, Preparation and Application of Materials Used in the Construction and Operation of Furnaces—By F. T. Havard, E. M., Associate Professor of Metallurgy, University of Wisconsin; Consulting Metallurgist to Goldsmith Bros. Smelting & Refining Co. New York and London: McGraw-Hill Book Co. Cloth; 6x9½ in.; pp. viii + 356; 123 illustrations. $4, net.

This is an elementary textbook dealing more particularly with the chemical side of metallurgy and intended to reduce to system many of the elementary chemical exercises customarily presented to students in technical schools. It is divided into two parts, namely: Chemical Arithmetic (206 pages) and Calculation of Furnace Charges (92 pages).

A great variety of chemical calculations are explained, covering almost everything from the simplest examples of the weights of constituents in ordinary reactions, to the determination of the proximate analysis from a knowledge of the ultimate analysis; the determination of the specific gravity of alloys and metal mixtures from a knowledge of the properties of the components, etc. Many valuable hints and simplifications of method are given upon the important subject of the calculation of furnace charges, which has puzzled so many young chemists and metallurgists, yet which is so valuable an aid to advancement. The furnace charges cover both iron furnaces and non-ferrous furnaces, but the majority of the work is non-ferrous.

There are many tables throughout the volume which are useful as reference in connection with the subjects discussed, as well as for general consultation generally by chemical and metallurgical engineers. The explanations are clear and concise, making the study unusually interesting.

This book is an elementary treatise on the physical and chemical properties, the methods of preparation and application, and the use of those materials of which industrial furnaces are constructed. In the author's own words, it "does not represent so much an attempt to write the last word on Refractories and Furnaces as an endeavor . . . . to create some kind of order out of the chaos which has enveloped the study."

Following an interesting introduction on the history and development of the brick industry, Chapter I (4 pp.) deals with the classification of refractory materials. From the author's method of classification we think many will dissent, since he calls pure alumina a basic refractory and cement a neutral one. Chapter II (10 pp.), "The Relation Between Slags and Refractory Vessels and Linings," is especially valuable for beginners, and also contains useful data on melting temperatures. Chapters III, IV and V, dealing respectively with "The Preparation of Silicious Refractories" (25 pp.), "Refractory Clays" (32 pp.), and "The Basic and Neutral Refractories" (25 pp.), are clearly written, interesting and concise. Chapters VI, VII, VIII and IX, treating respectively, "Refractories used in the Metallurgy of Iron and Steel" (29 pp.), "Copper" (22 pp.), "Lead, Silver, etc." (19 pp.), and "The Chemical and Electro-metallurgical Industries" (21 pp.), contain much new information of real value, presented in a clear and elementary fashion. Then follow chapters on instances of applications of bricks (9 pp.), some important theoretical considerations of the construction of furnaces (12 pp.), the manufacture of refractory hollow ware (25 pp.), testing of refractories (25 pp.) and the thermo-physical properties of furnace materials (27 pp.), in which are collected many data of value and importance to all metallurgists and mechanical engineers. Chapter XV, on "Heat Measurements" (17 pp.), and XVI, "The Preparation and Use of the Common Kinds of Brick," with an appendix containing seven tables of miscellaneous data related to the subject of the book, complete a volume which, we think, will occupy an important place in textbook literature and also serve as a valuable handbook for all persons interested in refractories and furnaces.

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Marine Engine Design

Reviewed by D. W. TAYLOR*

COMPUTATIONS FOR MARINE ENGINES—By C. H. Peabody, Professor of Naval Architecture and Marine Engineering, Massachusetts Institute of Technology. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. v + 209; 51 text figures. $2.50, net.

The book crystallizes, as it were, a portion of the course given marine engineering students at the Massachusetts Institute of Technology which involves the preparation of the design of a marine engine. Professor Peabody, in this volume, gives the methods used in calculating dimensions, etc., with discussions of underlying principles. Details of construction are not dealt with, but only such matters as sizes.

In Chapter I of 65 pages there is given a statement of horsepower and other preliminary data for a 3-cylinder, triple-expansion engine, and starting with this, methods and formulas are given for determining approximately the sizes of pistons, piston rods, connecting-rods, shafts, bearings, etc. In Chapter II of 38 pages there is taken up in some detail the question of the theoretical indicator diagrams to be expected with any combination of cylinder sizes and arrangement, receiver volumes, clearances and expansions. Having then approximate indicator diagrams and the approximate weights determined in Chapter I, in Chapter III of 20 pages there are taken up such questions as the effects of inertia and the acceleration forces. This puts the designer in a position to determine the actual reciprocating and rotary forces and in Chapter IV of 46 pages the final calculations of stress and determinations of sizes are taken up.

Chapter V of 30 pages is devoted to the question of balancing engines and the vibration of ships and Chapter VI of 7 pages touches briefly some of the modifications in steam-engine-design methods that will be necessary in connection with internal-combustion engines. Chapter V, on balancing engines, would be improved by the inclusion of matter upon the subject of torsional vibrations. These have given trouble in some cases of late years and should always be taken account of in the design of quick-running engines.

In Equation I on page 171, for the time of vibration of a spring, it is not stated whether the time expressed by t is in seconds. This is undoubtedly the case but on the same page the same symbol t is used to express time of vibration in minutes. There is no universal agreement as to what is meant by the time or period of vibration, or oscillation, of a body with periodic motion and there is need for close definition when dealing with the subject. The time of vibration given by Professor Peabody is for a single vibration, that is to say; as from one extreme position to the opposite. There is good ground for stating the matter thus. We always find the length of a seconds pendulum given as about 39" and such a pendulum takes one second to swing from one extreme position to another.

We find also, however, that good authorities use as the period of a vibrating or oscillating body the time of a double vibration or the cyclic period from the time when the body passes a given position going in one direction to the time when it again passes the same position going in the same direction. The latter definition of period fits the mathematics of such cases better and hence would seem preferable but either way of stating the period would be quite satisfactory if universally used.

The typographical work is excellent, the only error noted being on page 168 where "expansion," in the third line from the bottom, should be "expression."

This is a very good book as far as it goes but it is not

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possible in 206 pages of text and 61 line diagrams to cover exhaustively the field of marine-engine design It is to be hoped that future editions will be expanded into a reference work of greater value for the graduated designer. For a technical student the book as it stands is excellent.

Fixed and Movable Dams

Reviewed by EMIL KUICHLING*

HANDBUCH DER INGENIEURWISSENSCHAFTEN—Part I, Vol. 2; Der Wasserbau, Stauwerke. Fourth Edition. By Th. Rehbock, K. E. Hilgard and P. Gerhardt. Leipzig: Wilhelm Engelmann. Paper; 8x11 in.; pp. xi+522; 502 text illustrations; 14 folding diagrams. 36 marks.

This handsome volume belongs to the well known series of treatises constituting the "Handbook of Engineering Science," which is now appearing in its fourth enlarged edition. It deals exclusively with the design and construction of fixed and movable dams and fishways of moderate height, and leaves to other companion volumes the consideration of special works for controlling the channels and navigation of natural streams, and the construction of high reservoir dams.

The book is divided into four chapters and 37 sections. Chapters I and II, covering 182 pages with 121 text illustrations and three folding plates, were written by Prof. Th. Rehbock, of Karlsruhe, and relate to the functions of fixed dams, the action of the overflowing water, the influence of different forms of cross-section on the discharge and bed, new experimental values of the coefficient of discharge over sharp-edged weirs under different conditions of action, the character of the foundation, and details of construction at many different places, embracing both solid and hollow types of section. The use of various kinds of material is also fully considered and illustrated. Hydraulicians will find much interesting matter in the discussion of the discharge over weirs based on numerous recent experiments that were made with great care in the hydraulic laboratory of the Polytechnic School of Karlsruhe under Prof. Rehbock's direction.

Chapter III, covering 271 pages with 319 text illustrations and 11 folding plates, was written by Prof. K. E. Hilgard, M. Am. Soc. C. E., of Zurich, and relates to movable dams or barriers of eight different types, viz: Stop-timbers, needles, roller curtains, rectilinear gates, Taintor or segmental gates, folding wickets or shutters, bear-trap gates, drum, angular and sector-gates, and large cylindrical roller gates. A brief historical account of the development of these different types of construction adds much to the reader's interest, and it is gratifying to find therein that American engineers have contributed numerous important devices and built structures of great magnitude in successful operation. Each type of dam is well illustrated, and much attention is given to the necessary computations, as well as to the details of the mechanism and operating machinery. The last section of the chapter is devoted to an excellent review of the applicability of the various kinds of movable dams to different streams, and to the precautions that must be taken in design and construction; and the chapter concludes with a long list of references to the literature of the subject.

Chapter IV deals with Fishways, and embraces 46 pages with 62 text illustrations. It was written by Privy Councilor P. Gerhardt, of the Department of Public Works in Berlin, and sets forth the importance of conserving national fishery interests, together with many observations in regard to the habits and migrations of food fish, and the appliances that have been devised to enable them to pass over dams of moderate height in rivers. The underlying principle of all these devices is to reduce the velocity of the water flowing through a stair-like series of short channels to such extent that fish can readily ascend from the lower compartment to the succeeding higher ones; and the author describes the various ways in which a satisfactory solution of the problem has been sought to be accomplished, along with the results actually attained thereby. The chapter closes with a useful list of references to German and French publications.

The volume under consideration is well written and finely illustrated, so that it cannot fail to become a very valuable book of reference to the subjects treated. Its companion volume now in press will deal with high dams and reservoirs.

CONFERENCES ON WEIGHTS AND MEASURES OF THE UNITED STATES—Reports of the Sixth and Seventh Annual Conferences, held Feb. 17-18, 1911 and Feb. 15-16, 1912. Washington, D. C.: Bureau of Standards. Two volumes. Paper; 7x10 in.; pp. 157 and 186, respectively; illustrated.

The proceedings of the Sixth and Seventh Annual Conferences on Weights and Measures held in Washington, D. C., 1911 and 1912, have been published in book form. For the most part these books consist of stenographically reported discussions of various subjects, to which there is no subject index; hence the value of the books for reference is not very great. The report of the Seventh Conference contains a paper on "Platform Scales," by C. A. Briggs of the U. S. Bureau of Standards, and one on "Car Weighing" by the same author which are of some engineering interest.

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Four Elementary Texts in Electricity

ELEMENTARY PRINCIPLES OF ELECTRICITY AND MAGNETISM FOR STUDENTS IN ENGINEERING—By Robert Harbison Hough, Assistant Professor of Physics, and Walter Martinus Boehm, Instructor in Physics, University of Pennsylvania. New York: The Macmillan Co. London; Macmillan & Co., Ltd. Cloth; 5x8 in.; pp. vii + 233; 95 text illustrations. $1.10, net.

ESSENTIALS OF ELECTRICITY—A Textbook for Wiremen and the Electrical Trades. By W. H. Timbie, Head of Department of Applied Science, Wentworth Institute, Boston, Mass.; formerly Instructor in Industrial Electricity, Pratt Institute. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5x7 in.; pp. xiii + 271; 224 text figures. $1.25, net (5s. 6d., net).

A FIRST BOOK OF ELECTRICITY AND MAGNETISM, for the Use of Elementary Science and Engineering Students, and General Readers. By W. Perren Maycock, M. Inst. E. E. Fourth edition, thoroughly revised and considerably enlarged. London, England: Whittaker & Co. New York City: Macmillan Co. Cloth; 5x7 in.; pp. xxii + 351; 162 text illustrations; 2s. 6d., net.

ELECTRICAL ENGINEERING FOR MECHANICAL AND MINING ENGINEERS—A Series of 20 Lectures Prepared for and Delivered to the Resident Mechanical Engineers of the Mines of the Witwatersrand, South Africa. By H. J. S. Heather, M. Am. Inst. E. E., Late External Examiner in Electrotechnics to the University of the Cape of Good Hope and the South African School of Mines and Technology. [Being part of "The Electrician" Series.] New York: D. Van Nostrand Co. London: The Electric'an Printing & Publishing Co., Ltd. Cloth; 5x9 in.; pp. ix + 332; 184 text illustrations. $3.50, net.

Professors Hough and Boehm have developed their manual on strictly academic lines and from the physics teachers' point of view (mathematical physics at that) rather than from any idea of direct engineering application. A knowledge of trigonometry is necessary to understand the subject as presented. In general the method is to work out the several laws and show what sort of experiments are needed to verify the phenomena. The authors do not enter into the details of any experiments, but leave this to the instructor making use of the book. The laws of magnetism and electrostatics are developed in parallel ways before electro-dynamics are taken up. The properties of currents are briefly reviewed and followed by a study of the magnetic field of currents and the laws of current flow. The work comes closer toward daily practice when networks of conductors are considered, or specific resistance, or methods of measuring resistance, but still this is presented as would be expected from the pure physics point of view. A fundamental exposition of electro-magnetic induction, magnetic circuits, the inductive generation of voltage, the effects in alternating-current circuits are presented in the same fashion. Finally, there is a chapter entitled "Dynamo Electric Machinery" in which is the nearest approach to apparatus of common experience. The mathematics of underlying physical theory is outlined here.

The little book by Mr. Timbie presents as great a contrast to that of Hough and Boehm as can be imagined. It is for trade-school students and it aims to explain fundamental laws of electrical science by generalizing everyday phenomena and by very gradual steps in the study of theory behind common electrical apparatus. The ideas are clear and unmistakable; their presentation is perhaps the nearest approach that a technical work can have to imaginative writing. On account of these characteristics, the book ought admirably to suit its intended readers—aspiring workmen in the electrical industries.

First the flow of electricity is shown by hydraulic analogy and Ohm's law is gradually led up to. Simple electrical circuits are explained with diagrams and Ohm's law is applied to a number of specific cases. Then more complicated circuits are pictured and preceding laws shown to apply. The conception of electric power is approached through a hydraulic analog and the current-voltage requirements of lamps, heaters, trolley-cars, etc. The design of conducting lines proceeds from an analysis of resistance into the factors of length, area of cross-section and resistivity, and involves the preceding applications of Ohm's law. The theory of direct-current-dynamo electric machinery is presented qualitatively only, and here the first discussion of

magnetic phenomena appears. Following this section is a chapter on the troubles apt to be found in operating direct-current motors and generators. The best application of batteries (voltaic cells) for specified service is taken up, and under the head of "wiring diagrams" the action of electric bells, annunciators, alarms, igniters, the telegraph and telephone, railway block signals, electric track switches, carriage-call signals and energy meters are explained.

There are a few peculiarities in the inclusion of subjects, and a number of very evident omissions for a book that carries the title "Essentials of Electricity" and endeavors to make the ambitious workman well informed. For instance, commutating poles on generators are pictured and described as designed "to keep the brushes from sparking on heavy loads," but an explanation of the very important function of the commutator in producing uni-directional current is not attempted. Networks of conductors is almost presented, but the single small step to the current relations therein (Kirchhoff's laws) is not taken. There is nothing about fuses and circuit-breakers, which surely are everyday apparatus. There is nothing about wireless telegraphy, though this is a subject on which every electrical trade worker must desire information and the theory of which can be simply outlined. Most surprising of all is the omission of all reference to alternating currents, to the peculiar mysteries of alternating-current circuits, and to such commonplace matters as choke coils, transformers, synchronous and induction motors, and long-distance power transmission. For this last group of omissions there must be some good reason in the author's mind, though we cannot guess it, for certainly he has the ability to present these subjects as lucidly as he has the direct-current topics.

Mr. Maycock reports that as a teacher he has experienced the need of a textbook that would give an easier approach to the "elementary" but still difficult first texts like Stewart and Gee's Physics. The book has many appearances of an experimental guide but careful reading shows it to be more of a descriptive treatise with a few illustrative experiments. In some cases details for an experiment are given but more often only such mention is made as would suggest the experiments to a lecturer.

The author realizes the need, under modern conditions, of breaking away from the academic procession of the laws of magnetism and electrostatics, at least for "first books," and the gain from gradually leading the present-day young people from the realm of now common phenomena into strange fields.

This book starts out with a brief statement of familiar topics in magnetism. There is nothing quantitative here or even definitely stating actual "laws." Currents are next taken up by considering, according to a fluid theory, electrification potential, insulators and conductors, chemical cells, Ohm's law, general current effects, electromagnets, measuring instruments, electrolysis and electroplating, induced currents, generators and motors. Finally the time-honored subject of electrostatics is studied in the usual topical divisions.

There is no mathematics in the volume—if we except such shorthand notations as $C = E/R$ (Ohm's law) or $E \propto 1Fv$, (potential generation). Even these stop there with no appreciable algebraic manipulation.

The conditions under which Prof. Heather's text was arranged were peculiar, and on that account the book may be of particular service in somewhat similar situations which we expect may easily arise. We are told that in 1908 it was decided to abandon the direct production of steam power for driving the gold-mining machinery in a large proportion of the Rand (South African) mines and to substitute electricity and compressed air. The resident mechanical engineers in charge of machinery at these places were not, of course, expert electrical men, and the mine electricians under them did not possess capabilities of a high order, on account of the comparatively slight use of electricity up to that time. It appears, then, that the local industry would find itself short of men capable of taking engineering charge of the mines under the new conditions unless these mechanical engineers were able to acquire a working knowledge of electrical theory and apparatus, accordingly these lectures were arranged with that idea in view. The author has attempted, so to speak, to draw these men over the high spots of the art and science which they are most apt to bump under the new workings. In considering the details of these lectures, it should be borne in mind that these students were presumably skilful mechanical engineers with trained minds.

About one-fourth of the volume is devoted to the discussion of the properties of electrical circuits under steady and alternating currents. Between this and the more immediately practical parts are a few pages on the theory and construction of electrical instruments, etc. Another short section discusses the theory of direct-current generators and motors, but says nothing about the mechanical design and construction, which presumably these men were perfectly capable of analyzing for themselves. Nearly twice as much space is devoted to alternating-current generators and motors, proceeding in the same fashion through the electrical theory and non-mechanical design. The author also notes some of the prominent features of electrical design, such as the voltage and current reactions, of transformers.

So far alternating-current phenomena have been discussed largely with reference to single-phase installations only, since these show all the peculiarities in a simple manner. Finally the author refers to polyphase arrangements, looking at them as combinations of single-phase systems. The rotating field is discussed with particular care, and also the saving in conductors that is secured with polyphase power transmission. The section on induction motors, comprising about 10% of the whole book, follows familiar lines of presentation. The final lectures discuss the effect of running under abnormal conditions. Here are discussed the effect of changes in speed, frequency, voltage, current and power factor, from the values intended for daily operation. The change in machine losses is generally made the basis for the discussion of abnormal conditions, and the effect described for specific cases, like direct-current generators, direct-current motors, alternating-current generators, transformers, and induction motors.

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The Thermodynamics of Turbines

Reviewed by WINSLOW H. HERSCHEL*

THERMODYNAMIK DER TURBOMASCHINEN. By Dr. Ing. Guido Zerkowitz. München und Berlin: R. Oldenbourg. Cloth; 6x9 in.; pp. viii + 172; 89 illustrations. 6.50 Marks.

In recent years there has been a steady improvement in rotary machines. Centrifugal pumps, steam turbines, and more lately centrifugal compressors and gas turbines have tended more and more to displace or compete with the corresponding reciprocating types. The books on thermodynamics have not kept pace with this development, but have laid the emphasis on reciprocating machines, while all that referred to turbine machines was for the most part put in small type or omitted entirely.

Dr. Zerkowitz has emphasized these neglected phases of thermodynamics, and has collected from the technical journals a large amount of material not previously available in book form. Special attention has been given to graphical methods, and since the PV diagram has much less significance for turbine than for piston machines, the entropy diagram has been very largely used, though in many cases cycles are shown on both the PV and entropy diagrams for comparison. Another use of graphical methods is in determining the number of stages in a steam turbine by means of Fig. 48, the largest diagram in the book.

As might be expected, more than half of the total of 172 pages are taken up with the most important turbine machine, the steam turbine; and some 44 pages with the centrifugal compressor, a less developed but very promising machine essentially different from an ordinary ventilator fan. Dr. Zerkowitz considers the possibility of using turbines instead of piston machines in refrigeration, but concludes that there would be little prospect of benefit by the change. He also considers gas turbines briefly because these machines have never given an efficiency equal to that of the ordinary gas engine. At the end of the book is a very convenient table of symbols with their meaning.

In conclusion, the book is not suitable for a textbook except for very advanced classes, but is well adapted to serve the needs of designing engineers, specialists in the limited field which the author has treated.

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PRACTICAL MATHEMATICS, Being the Essentials of Arithmetic, Geometry, Algebra and Trigonometry. Part IV, Trigonometry and Logarithms—By Claude Irwin Palmer, Assistant Professor of Mathematics, Armour Institute of Technology. New York and London: McGraw-Hill Book Co. Cloth; 4x7 in.; pp. xi + 147; 68 text figures. 75c., net.

Part IV on trigonometry and logarithms completes Prof. Palmer's set of little books on "Practical Mathematics." The earlier volumes were reviewed in our issues of Dec. 12, 1912, and Apr. 17, 1913. The first 30 pages are devoted to logarithms. The text is simple and lucid as in the former volumes,

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and the book is of a very handy size. The text is designed for beginners and contains all the essentials for a thorough grounding in this branch of mathematics so essential to engineering calculations. The part on trigonometry covers 100 pages. The explanations and illustrations not only answer the purpose of expounding the essentials of trigonometry, but serve to explain the solution of many common problems in mechanics and surveying.

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Heat Flow through Solid Bodies

Reviewed by IRVING LANGMUIR*

AN INTRODUCTION TO THE MATHEMATICAL THEORY OF HEAT CONDUCTION. With Engineering and Geological Applications—By L. R. Ingersoll, Associate Professor of Physics, and O. J. Zobel, Formerly Fellow in Physics, University of Wisconsin. Boston, Mass.: Ginn & Co. Cloth; 5x8 in.; pp. vi + 171; 24 text illustrations. $1.60.

As its title indicates, this book deals with the theory of the flow of heat through solid bodies. The aim of the authors has been to develop the subject in such a way as to bring out the broad bearing and the generality of the methods of analysis, yet avoiding undue stress on purely mathematical derivations such as uniqueness, existence and convergence theorems. Especial emphasis is laid on the many applications to which the results are susceptible, each chapter being divided into two parts, the first dealing with the derivation of the equations and discussions of the methods, while in the second various applications are considered, usually with the numerical solution of actual problems.

The authors presuppose on the part of the reader a good working knowledge of differential and integral calculus, but no previous acquaintance with differential equations. The book really serves as an excellent introduction to the study of differential equations.

The book is divided into nine chapters. First an introduction discussing the laws of heat flow and their field of application. Then a chapter on linear differential equations. The steady flow of heat both in one dimension and in more than one dimension is the subject of the next two chapters. The fifth chapter treats the periodic flow of heat, such as seasonal temperature waves in the soil or in concrete walls. The stresses produced in walls by periodic temperature changes are also considered.

The sixth chapter deals with Fourier's series which is presented in a very clear manner and is well illustrated by a large number of curves showing the degree of approximation that may be attained by using a limited number of terms of the series. Three pages are devoted to a description of the Michelson and Stratton Harmonic Analyzer.

The seventh and eighth chapters, which comprise more than half the whole book, deal with the flow of heat in one dimension and in more than one dimension through solid bodies under various initial and boundary conditions. In each chapter five cases are considered, each illustrated with one or more applications of more or less practical interest. For example: Thawing of frozen soil; removal of shrunk fittings; cooling of lava under water; electric welding; theory of the fireproof wall; copper converter, annealing of castings; heating of spherical safes exposed to fire.

Unfortunately the authors have failed to consider the problem of the rate of heating of the electric oven or furnace which, although of great practical importance today, is rarely treated in textbooks.

Although the authors may be justified in excluding such subjects from a "mathematical theory of heat conduction" they would have rendered their book much more valuable to engineers if they had given more space to the consideration of the effects of convection and radiation, which so often, in practical applications, seriously limit the usefulness of the mathematical calculations.

The last chapter deals with various solutions of the problem of the rate of formation of ice. Eight pages at the end of the book are devoted to tables of values of thermal conductivity, tables of a few integrals and some mathematical functions.

To the engineer who wishes to acquire a working knowledge of Fourier's series and its application to problems in heat conduction the book can be warmly recommended.

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A "Select List of References on Scientific Management and Efficiency" fills nearly forty pages of "Special Libraries" for May (Special Libraries Association, 93 Broad St., Boston, Mass.; 25c. per number). The list was compiled under the direction of H. H. B. Meyer, chief bibliographer, Library of Congress, and is classified in such detail that one can readily find references on Accounting, Dressmaking, Education, Engineering, Government, etc.

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EXPORTERS' ENCYCLOPAEDIA (1913), Containing full and authentic information relative to shipments for every country in the world—New York: Exporters' Encyclopaedia Co., 78 Broad St. Cloth; 6x8 in.; pp. 1024; $7.50 per copy, including monthly corrections and the "Exporters' Review" for the calendar year.

While primarily intended as a guide book for shippers this book is of some interest to engineers who are officers of transportation companies or to those engaged in engineering work in foreign countries, where purchases must be made abroad. There are conversion tables for changing all foreign moneys to U. S. currency, directions for packing goods, explanations of commercial terms, protection of trademarks abroad, etc., which, while not of particular interest to the engineer at home, will, however, become of much interest and value to him if he shifts his field of operations to foreign countries.

The major part of the book is devoted to descriptions of all the countries of the world, giving their areas, forms of governments, imports and exports, industries, population and directions for shipping goods to them, with freight rates, from the principal ports of the United States. This part of the book is, of course, very valuable as a handy reference to the cosmopolitan type of engineer or to the business man whose field of activity extends beyond the boundries of the United States.

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INVESTIGATIONS AND EXPERIMENTAL RESEARCHES FOR THE CONSTRUCTION OF MY LARGE OIL ENGINE—By Prof. H. Junkers, Aix-la-Chapelle; a paper read before the Schiffbautechnische Gesellschaft at Berlin, Nov. 24, 1911; translated by Dr. Ing. Paul H. R. Nettmann, Aachen. Published by the General Oil Publishing Co., Ltd., 4 Broad Street Place, London, E. C. Price 2s. 3d.

The type of Diesel oil engine designed by Prof. Junkers has received wide attention in technical literature during the past two or three years. It is said that Prof. Junkers has spent over $300,000 in the design and development of his type of engine. The voluminous paper presented in this pamphlet is of interest, however, not merely because of its description of Prof. Junkers' invention, but because of its discussion of the foundation principles of the design of internal-combustion engines, a subject on which the amount of correct information available in the English language is unfortunately comparatively meager. Dr. Junkers' discussion of the heat flow in internal-combustion engine cylinders is an especially noteworthy contribution to the literature on that subject.

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AMERICAN RAILWAY ENGINEERING ASSOCIATION—Proceedings for 1913. Chicago (900 S. Michigan Ave.) Cloth; 6x9 in.; pp. 1491; numerous cuts and folding plates.

Several of the committee reports presented in March, 1913, deal with important investigations, and are worthy of special mention. The report on Rails covers some 400 pages and deals with specifications, inspection, tests of various kinds, the influence of titanium and silicon, the manufacture of sound ingots, and extended statistics regarding rail failures. The report on Yards and Terminals (42 pages) presents diagrams for analyzing graphically the train movements at large passenger terminals, thus greatly facilitating the arrangement of schedules and indicating how the traffic capacity of the station may be increased. Both of these reports are accompanied by a number of folding plates.

Individual papers (in addition to a number which form appendices to the rail report) include the following: "Dynamometer Tests and Train Tonnage Rating," R. M. Begien; "Locomotive Fuel Consumption in Relation to Speed," A. K. Shurtleff; "Tests of Long-Leaf Pine Bridge Timbers," H. B. MacFarland; and "Bridges over Navigable Rivers," C. E. Smith.

By a strange omission there is no list of officers and the title page does not even show in what city the association's offices are situated. The index is a very weak feature of the book, covering only six pages and being both incomplete and unsystematic. The table of contents, on the other hand, covers 18 pages and is unnecessarily detailed. The proportions of the "index" and "contents" should properly be reversed. The use of India paper has enabled the great number of pages and folding plates to be compressed into one rather bulky volume.

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PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

THE CATSKILL WATER SUPPLY OF NEW YORK CITY—History, Location, Sub-Surface Investigations and Construction. By Lazarus White, A. M., Am. Soc. C. E., Division Engineer, Board of Water Supply. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xxxii+748; 238 plates and text illustrations; $6, net.

CHICAGO BOARD OF SUPERVISING ENGINEERS ON TRACTION—Report for 1911. Chicago, Ill. Cloth; 6x9 in.; pp. 523; illustrated.

This report should prove of great interest to all engineers engaged in electric railway work. A feature is the free use of diagrams to express more graphically the relations between various operating data. Among these should be mentioned the distribution of the nickel fare (p. 23).

CHRONIQUE ILLUSTREE DU CONCOURS INTERNATIONAL DE TELEGRAPHIE PRATIQUE, Turin, 1911. Milan, Italy: Ferdinando Geronimi (Piazza Venezia, 2). Leatherette; 9x13; pp. 151; numerous illustrations. 20 francs.

CUERPO DE INGENIEROS DE MINAS DEL PERU—Estadistica Minera en 1911 por Carlos P. Jimenez. Boletin 78. Lima, Peru: Ministerio de Formento. Paper; 7x10 in.; pp. 80.

EUROPEAN CITIES AT WORK—By Frederic C. Howe, author of "The City: The Hope of Democracy," and "The British City: The Beginnings of Democracy." New York: Charles Scribner's Sons. Cloth; 5x8 in.; pp. xi+370; 11 illustrations; $1.75, net.

EXCAVATING MACHINERY—By Allen Boyer McDaniel, M. Am. Soc. C. E., Assistant Professor of Civil Engineering, University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xviii+340; 134 illustrations. $3, net.

A FIVE YEARS' FIGHT AGAINST FIRE WASTE and Its Possible Control in the United States by Fire Prevention and Protection [Comprising a series of addresses, showing the growth of an idea on this subject within five years—1908-12, inclusive]. By Powell Evans, Chairman Philadelphia Fire Prevention Committee. Philadelphia, Penn.: Merchant & Evans Co., 517 Arch St. Paper; 6x9 in.; pp. 180; 25c.

FOUNDRY-CUPOLA GASES AND TEMPERATURES—By A. W. Belden, Washington, D. C.: Bureau of Mines. Bulletin 54. Paper; 6x9 in.; pp. 29; illustrated.

FURTHER PROBLEMS IN THE THEORY AND DESIGN OF STRUCTURES—An Advanced Text-Book for the Use of Students, Draftsmen and Engineers Engaged in Constructional Work. By Ewart S. Andrews, Lecturer in Theory and Design of Structures at the Goldsmiths' College, New Cross, England. London, England: Chapman & Hall, Ltd. Cloth; 5x9 in.; pp. viii+236; 99 text illustrations. 7/6, net.

GOVERNMENT COAL PURCHASES UNDER SPECIFICATIONS, with Analyses for the Fiscal Year 1909-10—By George S. Pope; with Chapter on the Fuel Inspection Laboratory of the Bureau of Mines by Joseph D. Davis. Washington, D. C.: Bureau of Mines. Paper; 6x9 in.; pp. 97; illustrated.

THE IMPROVEMENT OF RIVERS—A Treatise on the Methods Employed for Improving Streams for Open Navigation by Means of Locks and Dams. By B. F. Thomas, M. Am. Soc. C. E., United States Principal Assistant Engineer, and D. A. Watt, M. Am. Soc. C. E., United States Assistant Engineer. Second edition, rewritten and enlarged. Cloth; 9x12 in. In Two Parts. Part I, pp. xiv+369; 83 text illustrations and 45 plates. Part II, pp. viii+415; 87 text illustrations; 38 plates. Set, $7.50, net.

INDIAN STORAGE RESERVOIRS WITH EARTHEN DAMS: A Practical Treatise on Their Design and Construction—By William Lumisden Strange, M. Inst. C. E. Second and enlarged edition. London, England: E. & F. N. Spon. New York: Spon & Chamberlain. Cloth; 6x9 in.; pp. xxiv+442; 59 text illustrations and 16 plates. 21s., net.

IOWA ROAD LEGISLATION, 1913—With Forms, Directions and Legal Opinions. Service Bulletin No. 1, Iowa Highway Commission, Ames, Iowa. Paper; 8x11 in.; pp. 73.

An article on the new highway law, by Prof. A. H. Marston, chairman of the Commission, apears on page .... of this issue.

LEGAL SPECIFICATIONS FOR ILLUMINATING GAS—By E. B. Rosa, Chief Physicist, and R. S. McBride, Assistant Chemist. [Technologic Paper 14]. Washington, D. C.: Bureau of Standards. Paper; 7x10 in.; pp. 31.

LIQUID STEEL; Its Manufacture and Cost—By David Carnegie, M. Inst. C. E., assisted by Sydney C. Gladwyn, A. M. Inst. C. E. New York and London: Longmans, Green & Co. Cloth; 6x9 in.; pp. xxv+520; 252 text illustrations and 10 plates. $7.50, net.

LIST OF WORKS RELATING TO ELECTRIC WELDING—Compiled by William B. Gamble, Chief of Division of Technology. New York: New York Public Library. Paper; 7x10 in.; pp. 23.

LOGARITHMS FOR BEGINNERS—By Charles N. Pickworth, author of "The Slide Rule," and "The Indicator: Its Construction and Application." Fourth edition. London, England: Whittaker & Co., and Emmott & Co., Ltd. New York: D. Van Nostrand Co. Cardboard; 5x7 in.; pp. 43; $1, net.

MADRAS PRESIDENCY (INDIA); PUBLIC WORKS DEPARTMENT—Administration Report for Year 1911-1912. Part II—Irrigation. Cardboard; 8x13 in.; pp. 265; illustrated.

DAS MACHINEN-ZEICHNEN. Begründung und Veranschaulichung der sachlich notwendigen zeichnerischen Darstellungen und ihres Zusammenhanges mit der praktischen Ausführung—Von A. Riedler, Professor an der Kgl. Technischen Hochschule zu Berlin. Zweite, neubearbeitete Auflage. Berlin, Germany: Julius Springer. Cloth; 8x11 in.; pp. viii+234; 436 text figures. 10 Marks.

NEW YORK STATE ENGINEER AND SURVEYOR—Annual Report of J. A. Bensel (Albany, N. Y.) for 1911-12. Vol. I. Cloth; 6x9 in.; pp. 394; illustrated.

ONTARIO HIGHWAY IMPROVEMENT—Report for 1912. Toronto: W. A. McLean, Provincial Engineer of Highways. Paper; 6x9 in.; pp. 60.

PRELIMINARY ABSTRACT OF STATISTICS OF COMMON CARRIERS for the Year Ended June 30, 1912. Washington, D. C.: Interstate Commerce Commission. Paper; 9x12 in.; pp. 171. Copies at 30c. each may be obtained from the Superintendent of Documents, Government Printing Office.

PROGRESS OF STREAM MEASUREMENTS—Report of Canadian Department of the Interior. By F. H. Peters, A. M. Am. Soc. C. E. Ottawa, Canada: Department of the Interior. Paper; 6x10 in.; pp. 311; illustrated.

THE PROPERTIES OF SATURATED AND SUPERHEATED AMMONIA VAPOR—By G. A. Goodenough and Wm. Earl Mosher. Bulletin 66. Urbana, Ill.: University of Illinois. Paper; 6x9 in.; pp. 94; illustrated.

THE PURIFICATION OF NEW YORK HARBOR—By George A. Soper, M. Am. Soc. C. E., President, Metropolitan Sewerage Commission. New York: William Wood & Co. [Reprinted from the Medical Record of May 17, 1913.] Paper; 5x8 in.; pp. 12.

RAINFALL, RESERVOIRS AND WATER SUPPLY—By Sir Alexander R. Binnie, Past President, Inst. C. E. [Founded upon the Chadwick Trust Lectures Delivered by the Author at the Institution of Civil Engineers in February, 1912.] New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. xi+157; 56 plates and illustrations. 50c., net.

RECLAMATION OF THE OVERFLOWED LANDS OF TEXAS—First Technical Report of State Levee and Drainage Commissioner Arthur A. Stiles. Austin, Tex. Paper; 6x9 in.; pp. 78; illustrated; complete file of topographic levee maps published separately.

RESUSCITATION FROM ELECTRIC SHOCK, Traumatic Shock, Drowning, Asphyxiation from Any Cause by Means of Artificial Respiration by the Prone Pressure (Schaefer) Method. By Charles A. Lauffer, M. D., Medical Director, Westinghouse Electric & Manufacturing Co. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 4x7 in.; pp. 47; 7 illustrations. 40c., net.

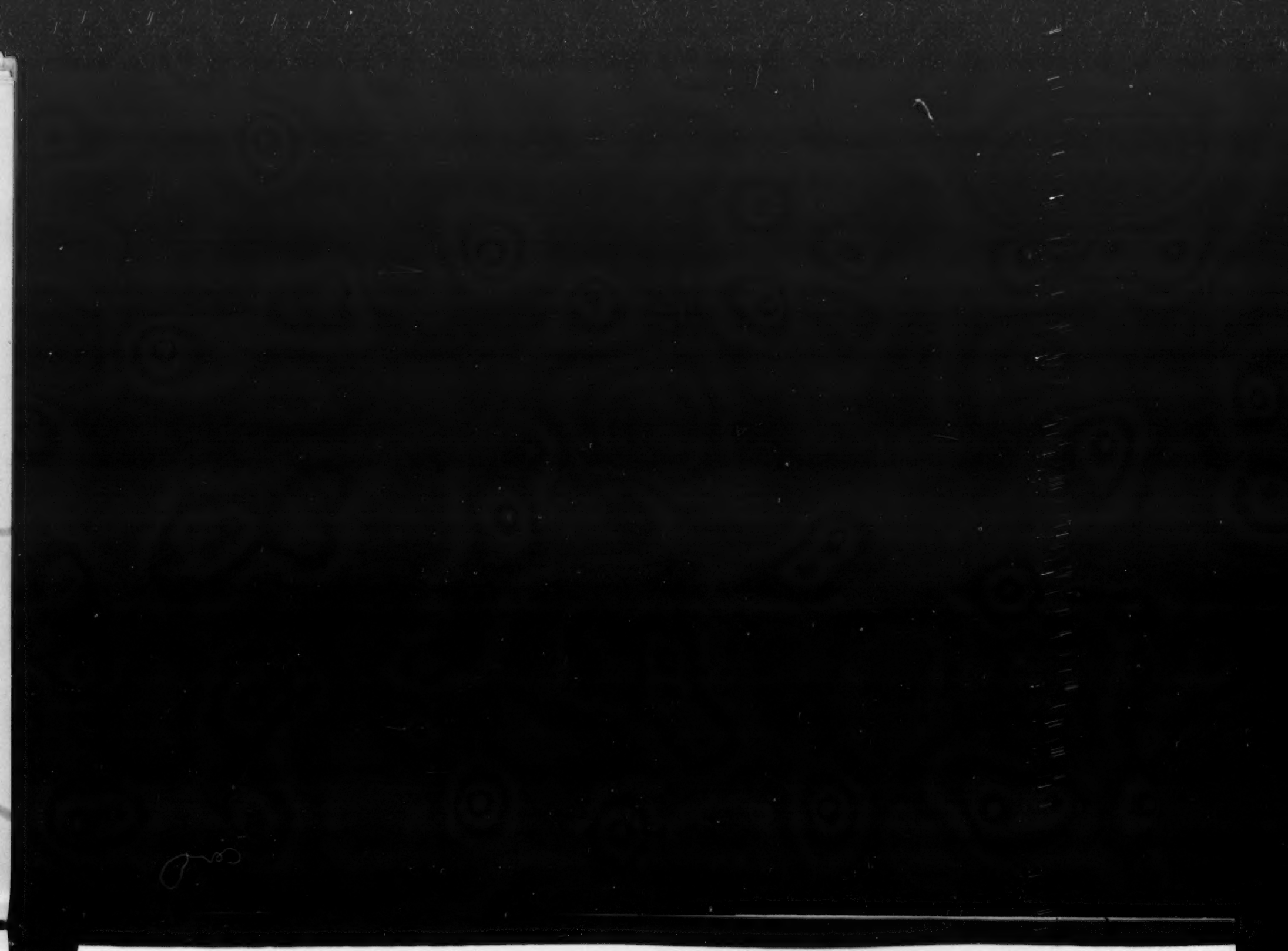
SAFETY METHODS FOR PREVENTING OCCUPATIONAL AND OTHER ACCIDENTS AND DISEASE—By William H. Tolman, Director of the American Museum of Safety, and Leonard B. Kendall. New York: Harper & Brothers. Cloth; 6x9 in.; pp. viii+422; 69 illustrations and 31 diagrams. $3, net.

STEAM POWER PLANT ENGINEERING—By G. F. Gebhardt, Professor of Mechanical Engineering, Armour Institute of Technology. Fourth edition, rewritten and reset. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. xvi+989; 609 text illustrations. $4, net.

A TREATISE ON WOODEN TRESTLE BRIDGES and Their Concrete Substitutes, According to the Present Practice on American Railroads—By Wolcott C. Foster. Fourth edition, revised and enlarged. New York: John Wiley & Sons, Inc. London, England: Chapman & Hall, Ltd. Cloth; 9x12 in.; pp. xix+440; 180 text illustrations and 76 plates. $5, net.

TYPHOID FEVER EPIDEMIC OF 1911 AT TORRINGTON, CONN—Report of James A. Newlands, Chemist of the State Board of Health. [Reprint from the Third Biennial Report of the State Board of Health, 1911-1912.] Hartford, Conn. Paper; 6x9 in.; pp. 166.

UNITED STATES COMMISSIONER OF EDUCATION—Report for Year Ended June 30, 1912. Vols. I and II. Washington, D. C.: Bureau of Education. Cloth; 6x9 in.; pp. 647 and 669, respectively.

WATER SUPPLY PAPERS—United States Geological Survey, Washington, D. C. Paper; 6x9 in.; illustrated. No. 292—Surface Water Supply of the United States, 1910, Part XII, North Pacific Coast—Prepared under the Direction of M. O. Leighton by F. F. Henshaw, E. C. La Rue and G. C. Stevens. Pp. 685. No. 314—Surface Water Supply of Seward Peninsula, Alaska—By F. F. Henshaw and G. L. Parker, with Sketch of the Geography and Geology by Philip S. Smith and Description of Methods of Placer Mining by Alfred H. Brooks. Pp. 317.

WOOD-USING INDUSTRIES OF VIRGINIA—By Roger E. Simmons, Statistician in Forest Products. Washington, D. C.: American Forestry Association. Paper; 6x9 in., pp. 88; illustrated.